

newscientist

ETHICS, IGNORANCE AND THE HUMAN EGG



Small-scale power • Tigers in Australia?

THE WORLD'S MOST EXCLUSIVE TAILORS

are generally reckoned to be Crocker and Devenish of New Burlington Street. Such is the perfectionism of these skilled craftsmen,



that both of them are involved in the cutting of each pair of trousers: Albert Crocker specialises in left legs, while his partner, Humphrey Devenish specialises in right legs. Since there is currently a twenty-five year waiting list for a suit, only those young gentlemen whose fathers were farsighted enough to put their names down at birth can hope to be considered as possible customers. Unless of course they are foreigners, in which case they will never be considered. There are two notable eccentricities about the establishment: in each of the fitting rooms there is a Harley-Davidson Electraglide motorcycle, so that the young blades can check the fit of

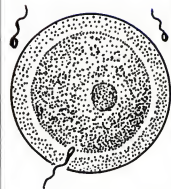
their trousers while in the saddle, and all customers are offered a glass of Merrydown Vintage Cider while waiting to be measured. This cider is produced in limited quantities each year by a unique blending process, and each bottle bears the date of the vintage on its label. The apples used in the fermentation are all fine English apples like Bramleys and Cox's, rather than the bitter little cider apples used in other brands designed for those with more "off-the-peg" tastes. It is available in two subtly differing varieties; Merrydown Vintage and Merrydown Vintage Dry. Should you be inclined to sample either, you should find that a reputable off-licence will come up with the goods even more promptly than your tailor.



Merrydown. Cider for the few.



A touch of science: interactive exhibitions go national, p 21



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This week's cover by CNRI (Science Photo Library): an electron microscope's view of a human egg, six days after fertilisation

NEXT WEEK

Patent medicine for American electronics

The knives are out between manufacturers of electronic chips in the United States and Japan. Lawsuits are flying in a battle that could change the shape of the industry

Talking trees

Chemistry beyond the molecule

newscientist



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Technology

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FEATURES

Experiments on animals

The House of Commons this week approved a bill to bring new controls on the use of animals in research

Gail Vines

Power from the people

Electricity generation is the latest do-it-yourself fad. Combine power generation and heat production and you could be more efficient than the CEBG

Dave Andrews

Japan has digital recording taped

Tape recorders are going the way of the black plastic record. But digital audio tape, unlike the compact disc, suffers from the lack of an agreed standard

Barry Fox

Tigers in Western Australia?

The last Tasmanian tiger died in a zoo 50 years ago. Or did it?

Athol M. Douglas

Why study early human development?

When does a fertilised human egg become an embryo? This is an emotive question. The answer will shape the future of research on infertility and inherited diseases

Anne McLaren

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Letters and Grimbledon Down

Ariadne

New Scientist is published weekly as a newspaper and printed in En USA Postmaster: Send address c 200 Meacham Avenue, Elmont, Publications Expediting Inc. 200 M © IPC Magazines. 1986.

This One



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The Wellcome Research Laboratories is the main research centre for the Wellcome Foundation Limited, the parent of an international group of pharmaceutical companies with headquarters in the United Kingdom and a current annual turnover in excess of £1000m.

We are currently looking for an additional person to join our Compound Information Section which is responsible for the development and maintenance of systems to provide R & D scientists with information on Wellcome research compounds.

You will apply your chemistry background in working with computer-based systems for handling chemical structures, and you will be responsible for data input and validation, updating and answering scientist enquiries. There will also be the opportunity to assist in developing systems to take full advantage of recently installed chemical graphics software.

You should possess a degree, or equivalent qualification, in chemistry together with some computer experience. An interest in information science, together with good communication skills in interacting with staff from different disciplines are also essential requirements.

We offer an attractive salary, dependent upon qualifications and experience, together with excellent company benefits including five weeks' holiday, pension and life assurance scheme, subsidised restaurant and first class sports and social club facilities. Assistance with relocation expenses will be considered where appropriate.

Please write with full career details to Miss E. M. Josset, Personnel Officer, The Wellcome Research Laboratories, Langley Court, Beckenham, Kent BR3 3BS, quoting reference no. 412.



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LONDON WC2

Please quote ref T28



AFRC INSTITUTE OF FOOD RESEARCH NORWICH LABORATORY Microbiology Division YEAST BIOTECHNOLOGY CLONING OF PLANT GENES IN YEAST

The Institute of Food Research is increasing its involvement in yeast molecular biology and plant cell culture by forming a group to clone plant genes, coding for secondary metabolite products, into *Saccharomyces cerevisiae*. A new group of seven scientists will expand an existing Yeast Biotechnology Group, currently consisting of five geneticists and molecular biologists, and the leader of the new project will also be responsible for yeast biotechnology as a whole. There will be close liaison with the Plant Cell Culture Group, investigating the production of secondary metabolites in plant cells.

The posts available are as follows:
SENIOR SCIENTIFIC OFFICER
(Ref 85/NP11)

A plant molecular biologist to isolate and clone the genes coding for enzymes which participate in secondary metabolite production in plants. Experience in mRNA isolation and cDNA library construction is required.

HIGHER SCIENTIFIC OFFICER
(Two posts: Refs 85/NP/12, 85/NP/14)

A molecular biologist to extract and purify enzymes on pathways leading to the production of plant secondary metabolites (85/NP/12); a yeast molecular biologist to develop cloning systems for the transfer of plant genes into *Saccharomyces cerevisiae* (85/NP/14).

SCIENTIFIC OFFICER

(Ref 85/NP/15-temp appointment)
A yeast molecular biologist to work with scientists already in post to study the metabolism in *Saccharomyces cerevisiae* of the products of plant genes. This is a five year appointment.

Qualifications: Applicants for the posts should possess a first class or upper second class honours degree in an appropriate discipline. At least two years' relevant postgraduate experience is required for appointment to the Higher Scientific Officer grade and at least four years for Senior Scientific Officers. In both cases, a PhD is desirable.

Salary scales: Scientific Officer £4190-£851. Higher Scientific Officer £7788-£10 541. Senior Scientific Officer £9772-£12 653. Non-contributory superannuation scheme. The Agricultural and Food Research Council is an Equal Opportunities Employer.

Further particulars and application forms from: The Secretary, Mr V. H. Standley, AFRC Institute of Food Research, Colney Lane, Norwich NR4 7UA, quoting the appropriate reference. Closing date 8 May, 1986.

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Since we were established in 1977, we have become a powerful UK force in the pharmaceutical industry - thanks to our substantial investment in research and development. It's an investment that has helped us develop an impressive string of innovative new compounds.

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We have openings nationwide for motivated, enthusiastic people who have recently entered a scientific field but now wish to experience a dynamic and professional environment where rewards reflect your own effort and ability. In return you can look

forward not only to a highly attractive salary and a company car; but also to thorough and comprehensive product training. In addition our total commitment to a policy of internal promotion guarantees exceptional career prospects.

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65-87

Opportunities in Computational Modelling

The Rutherford Appleton Laboratory is a leading research establishment carrying out challenging projects in science and engineering. There are a number of vacancies for Research Associates to participate in projects in the Computational Modelling Group of Technology Division. Some of these activities are supported by the national Alvey programme and the European Commission's ESPRIT programme.

Computation Modelling has become very important, both nationally and internationally, in many aspects of engineering design and the Rutherford Appleton Laboratory is seeking to strengthen its team of research scientists working on these programmes. The projects in device and process simulation will require algorithmic and software developments in the following areas:

- * CAD/CAM Interface Specification
- * Interactive Computer Graphics on Single User Machines
- * Linear Algebra in Large Sparse Systems
- * Finite Element Discretisation of Nonlinear Systems
- * Error Analysis in Discrete Modelling
- * Automatic and Adaptive Mesh Generation in Three Dimensional problems

Applicants should have a good honours degree with a high mathematical and computing content, and preferably some appropriate post-graduate experience in one of the areas listed. They should have the ability to participate in the design and implementation of large software systems taking account of the rapid developments in the computer hardware, particularly the availability of highly parallel computing architectures.

Salaries which depend on age and experience will be within the following ranges:

Principal	£12865 - £18352 per annum
Senior	£10476 - £11781 per annum
Junior	£ 7701 - £ 8158 per annum

The more senior posts demand substantial relevant experience. Appointments will be made for three years in the first instance.

Contact Recruitment Office, Personnel Group, Rutherford Appleton Laboratory, Science and Engineering Research Council, Chilton, Didcot, Oxon OX11 0QX. Tel: (0235) 445435, quoting reference VN448.

Closing date for applications: 15th May 1986



Rutherford Appleton Laboratory

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0256 55955 (24 hrs) Sutcliffe Selection, 46/48 Essex Road, Basingstoke, RG21 1TB

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BIOS



(Consultancy & Contract Research) Ltd.

BIOS provides a wide range of Research and Development facilities and also acts in an advisory capacity to many pharmaceutical companies on the international scene. Due to expansion of the clinical research activities a vacancy has arisen for a Clinical Research Associate.

The Clinical Trials Department liaises closely with other disciplines within BIOS over all aspects of pharmaceutical R. & D. but is responsible primarily for the design and implementation of clinical studies on behalf of the pharmaceutical industry. The person appointed will work as part of a team on the organisation and conduct of clinical trials in hospital and general practice.

Approximately 1-2 years experience as a Clinical Research Associate within the pharmaceutical industry is critical and a willingness to travel extensively throughout the UK is also an essential requirement.

Applicants are invited to write with full details to: Keith D. Lilley, BIOS (Consultancy & Contract Research) Limited, College Ride, Bagshot, Surrey GU19 5ER. Telephone (0276) 73363.

CLINICAL RESEARCH ASSOCIATE

Faculty of Technology

Research Assistantships —three Posts

£6324-£7122

(pay award pending)

Applications are invited for Research Assistantships to undertake post-graduate research selected from the following fields:

Department of Mathematics and Statistics

(i) Knowledge base for the teaching of statistics

(ii) Numerical solution of multidimensional singular integral equations

(iii) An investigation into materials exhibiting large elastic deformations

(iv) Numerical Bayesian analysis and its applications

Department of Computing

The effects of users' perceptions in the design of expert systems

Department of Civil Engineering

Determination of wind loads on structures and applications in design

Applications should possess or expect to obtain a good honours degree in a relevant subject area. Research Assistants are expected to register for a higher degree with the CNAAB. Appointments are for a period of two years with a possibility of extension to a third year (fixed term contract) and are funded by the Polytechnic.

Further details can be obtained from the Personnel Officer, Plymouth Polytechnic, Drake Circus, Plymouth PL4 8AA. Tel: (0752) 264639. Application forms to be returned by Friday 16 May, 1986.



Plymouth Polytechnic

Drake Circus, Plymouth Devon PL4 8AA

THE MIDDLESEX HOSPITAL MEDICAL SCHOOL

London W1P 7PN

Department of Bacteriology

JUNIOR 'B'/MISO

with experience in clinical laboratory work required in this busy Department for up to eight months as a replacement for a member of staff on maternity leave. Please apply in writing to Mr H. Hammill at the above address, from whom further details may be obtained. Tel: 01-436 8333, Ext 7381.

RESEARCH DIRECTOR - Z A I R E -

A key appointment in a major programme of oil palm breeding

Unilever Plantations Group is an integral

part of the successful worldwide Unilever organisation, with 92,000 hectares of oil palm, rubber, coconut, cocoa and tea.

There are separate operating companies in each country and in the majority of companies, these are run as joint ventures between Unilever and local investors.

The important position of Research Director, Joint Research Scheme, has become available at Binga in Zaire. The Scheme, which is Unilever's main oil palm breeding programme, produces high yielding oil palm seed for Unilever Plantations, and for sale to third parties. In addition, the programme produces elite individuals for clonal propagation. The oil palm collection consists of 40,000 palms from many different origins, mostly planted in statistically designed trials and tested for resistance to fusarium wilt under field conditions.

The Research Director is responsible for

ensuring that the programme is run effectively and that long term objectives are reached. He/she will control the activities of over 100 staff.

Candidates must possess a degree in agriculture or plant science and must be fully confident in their ability to implement and evaluate genetic responses. Several years relevant field research experience are desirable.

Fluency in French is essential. The salary and benefits reflect the importance that Unilever Plantations Group places on this position. Career prospects are good within an organisation geared to recognising personal initiative and commitment.

Please write enclosing your CV to:

U Dr. Brian A. Scott,
Unilever Plantations Group, Unilever House, London EC4P 4BQ, England.

UNIVERSITY OF BIRMINGHAM FACULTY OF ENGINEERING

RESEARCH POSTS

Applications are invited for the following posts:

Chemical Engineering: Research Associate in Biochemical Engineering (T2)

A Graduate chemical/biochemical engineer is required to work on a co-operative project with a major contracting company on practical aspects of immobilised cell reactor design and performance. The appointment would be for a period of 10 months.

Chemical Engineering: Teaching Company Associate (T3)

A graduate mechanical or design engineering is required for a two year appointment for the design and specification of advanced equipment for biotechnological processes. The main requirement in this joint programme with the Life Science Laboratory Group is the ability to understand process engineering objectives in the context of equipment design.

Electronic & Electrical Engineering: Research Associate in VLSI design (S5)

A graduate with a good degree in electrical engineering or computer science and experienced in VLSI design, especially in logic simulation, placement and routing is required to work on a SERC grant to study the development of novel layout tools for VLSI design.

Salaries will be on the Research Associate 18 scale £7055-£9495 plus superannuation. For further particulars phone 021-472-1301 Ext 2559 quoting reference numbers above.

No formal application form. Three copies of application, including full cv and naming three referees to Assistant Registrar, Faculty of Engineering, PO Box 363, BIRMINGHAM B15 2TT by 9 MAY, 1986.

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Anglian Water

ASSISTANT ENGINEER (WATER RESOURCES) Location—Cambridge

Salary £9999 to £11 067

Cambridge Division is the largest of five divisions in Anglian Water, covering an area from West of Buckinghamshire to the North Norfolk Coast.

We have a new post in the Water Resources Section, forming part of a planning team of nineteen staff, created to cater for the computer application needs of the section. The post-holder will be responsible for initiating and developing computer software applications to promote the efficient development of water resources. This will involve close liaison with systems, scientific and operational staff, and applicants will need to be numerate, with logical thought.

The successful applicant will have a first degree in an earth science or a numerate discipline, and a second degree involving water resources technology and computer applications. At least two years experience in water resources processes and management is required together with a flair for software development in the fields of groundwater and surface water catchment modelling, data base management and raw water planning.

If you are interested in applying for this post please telephone Cambridge 61561, Ext 240 for an application form and job description, quoting Post Reference T.522.

Applications must be received by 9 May, 1986.

CAMBRIDGE DIVISION
Great Ouse House, Clarendon Road,
Cambridge CB2 2BL



1886-1986

Clinical Research Scientist

Upjohn Limited is the UK subsidiary of The Upjohn Company, a major international research-based pharmaceutical company, developing and supplying ethical pharmaceutical and animal health products worldwide.

The Clinical Pharmacology Unit within the Medical Division is responsible for early phase human research and development of pharmaceuticals. We have an opening for a Clinical Research Scientist to join this highly motivated team, working closely with the Scientists in the Pharmaceutical Research Laboratories. The responsibilities will include reviewing preclinical data and designing, managing and reporting on clinical pharmacology programmes. There will be some travel, mainly in the UK. This is an ideal developmental opportunity providing external and in-house training and the possibility of an honorary appointment within an academic Department of Pharmacology.

A PhD in Biochemistry, Biophysics, Pharmacology or Physiology, together with several years relevant experience, is required. Candidates should have a creative and thorough approach to research, combined with the versatility to cross interdisciplinary boundaries. Good interpersonal and communications skills are essential to ensure good interaction with volunteers and medical/scientific colleagues within the worldwide Upjohn Company.

The Company offers an attractive salary and benefits package (including company car, relocation expenses where appropriate, contributory pension scheme and free life assurance), career development and a pleasant working environment in an attractive part of the country.

Please write giving details of qualifications and experience to Pamela Gelder, Personnel Co-ordinator, Upjohn Limited, Fleming Way, Crawley, West Sussex, RH10 2NJ.

Upjohn



INSECT ECOLOGIST (New Graduate)

Plant Protection Division is one of the fastest growing businesses within ICI. Our Crop Protection products are used throughout the world and we have a major commitment to ensuring their environmental acceptability.

The successful candidate will be encouraged to develop field and laboratory research programmes in the area of pesticides and insect ecology and could also be called on to cooperate in other aspects of vertebrate and invertebrate ecological studies both in the UK and overseas.

This is a unique opportunity for a highly motivated new graduate in the life sciences who wants to pursue a challenging career that would equally well develop along technical or commercial lines. You will be numerate, have an aptitude for field and laboratory experimentation, an appreciation of organic chemistry and have a current driving licence. Above all, you will have to be adaptable, prepared to work to tight deadlines and to communicate the results.

Jealott's Hill Research Station is pleasantly situated between Bracknell and Maidenhead. The starting salary would be approximately £8000 pa with other benefits including profit sharing and pension. There is an active recreation club, a staff restaurant and a shop on site.

Please apply with full details of your age, qualifications and experience to date to: Personnel Department, ICI Plant Protection Division, Jealott's Hill Research Station, Bracknell, Berkshire RG12 6EY.

The closing date for these vacancies is 25 April, 1986.

Please quote reference RA8/JE.



Plant Protection Division



BROMPTON HOSPITAL

Lung Function Unit
MEDICAL PHYSICS
TECHNICIAN (GRADE 3/4)

The person appointed will be expected to conduct a wide range of respiratory tests in this busy unit on patients with pulmonary and cardiac diseases.

Salary according to age, qualifications and experience within range £6786-£9797 inclusive of London Weighting (pay rise pending).

Further information from Mr D. Cramer, Chief Medical Physics Technician, Tel 352-8121 Ext 4423.

Application forms and job description from Mrs J. Walton, Assistant Personnel Manager, Brompton Hospital, Fulham Road, London, SW3 6HP.

Tel as above, Ext 4456 (24 hour answering service). Closing date 7 May, 1986.

UNIVERSITY OF BATH

School of Chemistry
EXPERIMENTAL OFFICER

Applications are invited for an Experimental Officer to assist in the development of a single crystal X-ray diffraction facility within the Inorganic Group.

Candidates should have an appropriate background in X-ray crystallography, and the successful applicant will be expected to help provide a service for several of the expanding research programmes in the School.

Salary on the scale £7945-£9489 pa according to qualifications and experience.

Application forms and further details from the Personnel Officer, University of Bath, Bath BA2 1AY, quoting Ref No 86/62. Informal contact may be made with Dr B. J. Brisdon (0225 61224, Ext 517). Closing date: 9 May, 1986.

LUDWIG INSTITUTE FOR CANCER RESEARCH

Cambridge Branch

SENIOR RESEARCH OFFICER

Applications are invited for the above post from graduates with extensive tissue culture experience and some knowledge of molecular biology techniques. The successful candidate will be responsible for running the cell culture facilities for a small group working on mechanisms of oncogene activation.

Salary on the SRO scale £8977-£11452 with appropriate increments according to qualifications and experience.

Applications to The Administrator, Ludwig Institute for Cancer Research, MRC Centre, Hills Road, Cambridge CB2 2QH.

INSTITUTE OF NEUROLOGY

Department of Neurochemistry

RESEARCH ASSISTANT

Applications are invited for a research assistant position funded by the Medical Research Council to join a group investigating the role of gangliosides in neurogenesis. The project will involve extensive use of neural cell cultures and the preparation and characterisation of antibodies to gangliosides. The position is available for one year in the first instance, at a salary of £7055 plus London Allowance. Applications, together with cv and the names of two referees, should be sent to Dr F. S. Walsh, Department of Neurochemistry, Institute of Neurology, Queen Square, London WC1N 3BG.

Culture Collection Technician

Greenford

A position has been created for a technician to assume responsibility for the upkeep of the microbial culture collection. The work entails preparing organisms for preservation, supplying cultures for screening and fermentation development and maintaining a computerised record system.

Applications are invited from candidates with good technical qualifications (H. Tec or equivalent), experience in microbiological techniques, and who demonstrate a mature and responsible attitude for this type of work.

Salary will be in the scale £6,615 - £9,580 : £8,125 - £12,150 according to qualifications and experience. An outer London Allowance of £650 per annum is payable and there are two bonus schemes. The Company operates flexible working hours and there is a non-contributory pension scheme.

Please write or telephone for an application form to: Mr Ron Nolan, Personnel Officer, Glaxo Group Research Limited, Greenford Road, Greenford, Middlesex. UB6 0HE. Telephone 01-422 3434 extension 2934 quoting reference number 046.

Glaxo Group Research Ltd.



SCIENTIST

to work on water supply systems
£8,000 - £10,000 pa

WRc Engineering, based at Swindon in Wiltshire, is part of the largest Water Research organisation in the world, providing research and implementation support to the UK Water Industry.

A vacancy has arisen for a scientist to join a small team working on problems in water distribution systems. Initially, the work will involve the investigation of problems of discoloured water and the design of schemes for quantifying such problems. It may also involve the investigation of other problems resulting from the deterioration of water mains.

A graduate (or equivalent) in a scientific subject with a knowledge of chemistry is sought. Practical post-graduate experience (particularly in the water industry) would be an advantage but is not essential. The post will be based at Swindon, Wiltshire, but will involve extensive field work and liaison with staff of water undertakings. A current driving licence is essential.

Starting salary will depend on qualifications and experience. Conditions of employment include a contributory pension scheme. Relocation allowance will be paid where appropriate.

Ring Colin Evans or Sue Williams on (0793) 488301 for further information, or send a written application to the Personnel Manager, Water Research Centre, PO Box 85, Swindon, Wilts., SN5 8YR. Closing date: 8th May 1986.

WATER RESEARCH

WRc

ENGINEERING

Providing Water Technology Worldwide



Clinical Research Associate

Continued expansion within the U.K. Division Medical Department of Beecham Pharmaceuticals has created an opportunity for a talented person who can make an immediate contribution to the department's CNS trials programme.

Based in the Company's Head Office at Brentford, but travelling throughout the U.K., the successful candidate will be actively involved in the day-to-day management and monitoring of trials, validating and interpreting the clinical results.

Applicants, male or female should be graduates ideally with a second degree in a relevant scientific discipline. Some previous experience with clinical trials is preferable though applicants who have research experience related to human medicine will also be considered. The ability to communicate effectively, both verbally and in writing is essential as is the ability to win the co-operation of outside investigators in achieving the Company's objectives.

Attractive conditions of employment include a non-contributory pension scheme and free life insurance cover.

Please apply in writing giving full career details and salary requirements to: Mrs P. Butterworth, Personnel Manager, Beecham Pharmaceuticals, Beecham House, Brentford, Middlesex TW8 9BD.

Closing date: 2 May, 1986.

Beecham
Pharmaceuticals

MORE VACANCIES ON PAGES

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History of Science

RESEARCH ASSISTANT

A varied opportunity in the field of physical sciences to undertake designated research projects in assisting senior staff, the preparation of catalogues and historical papers for publication and in support of continuing research in the role of scientific instruments. Work towards registering new acquisitions, preparing displays and answering enquiries about the collections, is also included.

You must already have a degree, or an acceptable alternative qualification, in a relevant subject. Experience of museum work or historical research an advantage.

Salary (under review): as Curator E £8450-£11,265, or as Curator F £6300-£8915 according to qualifications and experience.

For further details and an application form (to be returned by 23 May 1986) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 468551 (answering service operates outside office hours). Please quote ref: G(13)382.

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NATIONAL MUSEUMS
OF SCOTLAND

UNIVERSITY
OF STRATHCLYDE
Department of Electronic and
Electrical Engineering

RESEARCH
ASSISTANT

Applications are invited for a two-year Research Assistantship funded by SERC/Industry to conduct fundamental research into the optical/mechanical/materials interactions involved in a novel technique, recently demonstrated by the Opto-electronics Group at Strathclyde, for sensing environmental parameters involving a combination of silicon micro-machining and fibre optics, and to evaluate possible transducer designs. Experience to postdoctoral or equivalent level is desirable in one or more of Optical Physics, Electronic Engineering, Semi-Conductor Technology or related subjects.

Salary on Range 1A (£8020-£12 780 per annum, USS benefit).

Applications (quote Ref R22/86) with full curriculum vitae and the names and addresses of three referees should be sent to:

Professor B. Culshaw
Department of Electronic and
Electrical Engineering
University of Strathclyde
Royal College Building
204 George Street
Glasgow G1 1XW
by 19 May, 1986

Reactor Physics
Assistant

Morecambe

£8,900 - £12,900 per annum

An opportunity has arisen with the Central Electricity Generating Board at Heysham 2 Power Station for a suitably qualified person to join the Reactor Physics team. Heysham 2, which is currently being commissioned, consists of two advanced gas cooled nuclear reactors and two turbines capable of supplying 1320 MW of electrical power to the National Grid.

The Reactor Physics Group is responsible for fault study analysis, safety assessments, fuel management and behaviour and performance modelling of the station's reactors. Extensive use is made of local and national computing facilities. During the commissioning phase the team will be responsible for establishing technical, administrative and recording systems and assisting in the formulation of Station Operating Instructions.

Candidates should be qualified to degree level in physics or a related subject and should be able to demonstrate written and oral fluency. Previous reactor physics experience would be an advantage but is not essential. Heysham is an attractive site on the coast close to Morecambe and Lancaster. It has good communications and is known as the gateway to the Lake District.

Application forms may be obtained from the Personnel Department, CEGB, Europa House, Bird Hall Lane, Chesidale Heath, Stockport, Cheshire, SK3 0XA (061-428 0711 ext. 2582). Completed forms should be returned to the Personnel Manager at the above address to arrive not later than 12th May 1986. Please quote Vacancy Number 83/51.

The CEGB is an Equal Opportunities Employer.

THE UNIVERSITY OF SHEFFIELD
DEPARTMENT OF MICROBIOLOGY

RESEARCH ASSOCIATE (2 POSTS)
RESEARCH STUDENTSHIP (2 POSTS)

Applications are invited for the following posts in the above department:

- (1) an SERC-funded project to study the molecular biology of bacterial spore germination. The project aims to analyse the developmental control of gene expression in a cloned spore germination (*gerA*) operon, and to determine the location and function in the spore of the encoded proteins. Applications are invited from workers with a sound background in microbial molecular genetics or biochemistry. The post is available from 1 October, 1986 for a period of approximately 27 months at a starting salary within the first four points of Range 1A on the scale for Research and Analogous staff (£8020-£9495 pa), according to age, qualifications and experience.
- (2) a PhD studentship, available for three years, for work on either complementary aspects of this project, or on the control of transcription of the *fumarase* (*citG*) gene of *Bacillus subtilis*.

Further information about these two posts is available from Dr Anne Moir (0742-78555, Ext 4415), to whom applications should be sent (address below).

Two further posts are available for work on Physiological characterisation of a thermophilic methylotroph, as follows:

- (3) Research Associate: applicants should have experience in the use of chemostats. The position is available from 1 July, for three years, and a salary will be within the first four points of Range 1A for Research and Analogous staff (£8020-£9495 pa).
- (4) Research Studentship: applicants should have, or expect to obtain, a first class or II Honours degree in Microbiology or Biochemistry. The post is available from 1 October, 1986.

The successful candidate for posts (3) and (4) will work in a group supervised by Dr M. Attwood and Professor D. W. Tempest. Applications should be sent to Dr Attwood.

Applications for all four posts should be sent to Dr Moir or Dr Attwood as soon as possible at the Department of Microbiology, The University, Sheffield S10 2TN quote ref: R408/H.



Senior Research Scientist

N.W. Cheshire: c£14,500

Shandon are leaders in the design and manufacture of clinical laboratory equipment. An aggressive R&D programme is at the heart of our expansion and to complement our team we now require a Senior Scientist with at least five years post-graduate experience, gained in a clinical laboratory environment. The ideal candidate will have broad experience of clinical laboratory techniques with an emphasis on histology. Experience of laboratory automation and instrumentation would be an additional advantage.

Your prime objective will be to identify and investigate new approaches and techniques in life science laboratory instruments... to improve existing products and develop new ones.

This is a particularly challenging and stimulating job which will have supervisory responsibilities and involve interaction with in-company departments and external organisations.

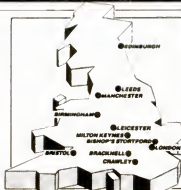
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Either telephone for an application form or write with full cv, to: **Allan Bush, Personnel Manager, Shandon Southern Products Limited, Chadwick Road, Astmoor, Runcorn, Cheshire WA7 1PR. Tel: 09285 66611.**

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QATAR GENERAL PETROLEUM CORPORATION



Qatar General Petroleum Corporation (Onshore Operations) is responsible for Qatar's Onshore Oil and Gas Operations.

The following vacancy exists in its Operational Areas and suitably qualified and experienced candidates are invited to submit their applications.

CARBONATE SEDIMENTOLOGIST

"QGPC possesses one of the most comprehensive collections of core material available anywhere. This material will be of particular interest to Carbonate Sedimentologists who wish to investigate the regressive depositional model, cyclical sedimentation and sea level changes".

Duties:

1. To study the carbonate sedimentology of core and cuttings sample material available in the Field core store.
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4. To assist in giving in-house training in reservoir geology and carbonate sedimentology.
5. To optimise the selection of samples for routine and special core analysis.

Education/Experience

Essential:

University Degree in Geology with at least two/three years post-graduate experience in Carbonate Sedimentology of Carbonate Microfacies Analysis.

Desirable:

PhD or MSc or Well-site geology and industry experience of at least two years.

Applications giving full details should be addressed to:

Senior Recruitment Supervisor
Qatar General Petroleum Corporation
(Onshore Operations)
P.O. Box 70, Doha - Qatar
Arabian Gulf.

ANALYST/ PROGRAMMER Pharmaceuticals

Horsham, West Sussex

Ciba-Geigy Pharmaceuticals enjoys a reputation as one of the leading pharmaceutical organisations in the United Kingdom, with an enviable record of success in marketing a diverse range of products. An essential part of this continuing success is the professional support offered by the Management Information Services Department.

Due to the establishment in Horsham of our new Advanced Drug Delivery Research Unit and the multi-million pound expansion of our Production facilities, we are now seeking to appoint an analyst/programmer to join the Research Support Group. This Group is responsible for the development of computer applications within all areas of the pharmaceutical research laboratories. The range of work covered by the group includes laboratory automation and the implementation of scientific applications onto microcomputers, minicomputers and mainframes.

We are seeking someone, educated to degree level, trained in a scientific discipline, who has worked for at least two years in programming with some experience in systems analysis. Familiarity with DEC operating systems would be advantageous, although training would be given to a suitable candidate.

We can offer a competitive salary, together with a range of other benefits which one would expect of a major multinational Company. These would include assistance with relocation costs, where appropriate.

Please write for an application form to:

Mrs. Lynette Meadus, Assistant Personnel Officer, Ciba-Geigy Pharmaceuticals, Wimblesbury Road, Horsham, West Sussex RH12 4AB – or telephone Sue Gigg on Horsham (0403) 50101, Ext. 3504.

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Freeport, London W2 1BR.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE POSTDOCTORAL RESEARCH ASSISTANT

Applications are invited from graduates in the biological sciences for a three year appointment funded by The Wellcome Trust within a programme on the epidemiology and immunology of leishmaniasis, with special relevance to the Amazon region. The appointee will be based at the London School of Hygiene and Tropical Medicine but will spend an initial year at Yale University, USA, developing monoclonal antibodies, for use at the Wellcome Parasitology Unit, Belém, Brazil, where the successful applicant will work for periods up to a few months at a time.

Applicants, who should have completed or be about to complete their PhD, will be appointed at an appropriate point on Research and Analogous Scale 1A: £8020 to £12 780 according to age, qualifications and experience.

Applications with full cv and the names of two referees should be sent to the Personnel Officer, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT.

Closing date 15 May, 1986. Please quote Ref DB1.

THE UNIVERSITY OF LEEDS Department of Organic Chemistry

DATABASE WRITER

Applications are invited for the post of Project Assistant (Database Writer) in the Wolfson Unit for Computer Aided Design of Organic Synthesis, Department of Organic Chemistry. The work requires a good knowledge of organic chemistry, particularly reaction mechanisms, and is concerned with the development of the database for the LHASA program. The post is financed by LHASA UK, a consortium of major pharmaceutical and agrochemical companies and educational establishments; the work will require considerable interaction with the member companies.

A good honours degree in Chemistry is required. Postgraduate work and/or an interest in chemical applications of computers would be an advantage but is not essential.

The post is available immediately for a fixed term of up to one year. There may be the possibility of a further fixed term contract thereafter.

Salary within the range £7055-£9495 on the IB Grade for Other Related Staff (£7055-£10 865), according to age, qualifications and experience.

Informal enquiries may be made to Dr A. P. Johnson (Tel [0532] 431751 Ext 6071 or 6058).

Application forms and further particulars may be obtained from and completed applications sent to:

The Registrar, The University, Leeds LS2 9JT, quoting reference number 45/42.

Closing date for applications: 15 May, 1986.

UNIVERSITY OF SURREY Department of Microbiology POSTDOCTORAL RESEARCH FELLOW IN MOLECULAR VIROLOGY

Applications are invited for the above position to join an active and expanding research group investigating the molecular basis of virulence and attenuation of yellow fever virus. The project will involve investigating nucleotide sequences of the yellow fever virus genome involved in reversion of the yellow fever vaccine virus to neurovirulence.

We are looking for candidates with enthusiasm and creative ability, and an interest in recombinant DNA technology and/or molecular virology. Candidates without experience can be given training, as these techniques are on-going in a number of research projects.

The starting salary will be up to £9495 on the Research & Analogous IA scale. The post will be available from 1 September, 1986 or at a later date to be arranged and will be for a period of three years. Superannuation under USS conditions.

Further details can be obtained from Dr A. D. T. Barrett on Guildford (0483) 571281, Ext. 2655. Applications in the form of a cv (three copies) and including the names and addresses of two referees should be sent to the Personnel Office (JLG), University of Surrey, Guildford, Surrey GU2 5XH by 16 May, 1986 quoting reference 404/NS.

amicon o GRACE COR

CHROMATOGRAPHY ULTRAFILTRATION

Amicon, a division of W. R. Grace and Co is a world leader in molecular separation technologies used in the life sciences and fine chemicals markets. Due to continuing success and sales growth, we are now seeking to fill two professional positions in our European technical group based in Gloucestershire.

Selected candidates will join a small dynamic team reporting to the European Technical Manager. Both positions are expected to play major roles in providing Amicon subsidiaries in Europe with the technical expertise essential for the high technology market in which we operate.

Process Systems Engineer

In this position you will provide mechanical/electrical engineering expertise for high value process ultrafiltration and chromatography systems sold in Europe.

Specific responsibilities will include, provision of engineering support in customer negotiations, setting specifications for customised process systems, follow up of product development, testing and other sales services. This will involve extensive travel within Europe.

Requirements include a degree, HNC or equivalent, with two to three years professional experience in mechanical and electrical engineering. Knowledge of separation techniques used in the chemical and/or pharmaceutical industries would be an asset but not essential. Specific training in ultrafiltration and chromatography will be provided.

Applications Chromatographer

In this position, you will be responsible for developing scale up methods to optimise customer requirements. This will involve the use of both analytical and process scale equipment.

Specific work will include, testing and evaluation of new products, the generation of applications data in support of the sales force and the provision of scalability studies for European customers wishing to expand process capacity.

Requirements include a degree in either chemistry or biochemistry and a wide knowledge and experience of high performance liquid chromatography.

Both positions will only suit highly motivated young professionals capable of working in a high pressure international environment. Candidates must be capable of working under their own initiative and be highly resourceful in finding solutions to problems.

In return, we can offer a challenging position with excellent career opportunities. Remuneration is commensurate with the positions offered and benefits in line with those offered by other major companies in the industry. Please write in the first instance, enclosing your CV to:

Mr D. McKane, Personnel Manager, Amicon Ltd, Upper Mill, Stonehouse, Glos GL10 2BJ.

UNIVERSITY COLLEGE LONDON IMAGE PROCESSING AND MACHINE ARCHITECTURES

Six Research Assistants

Required immediately for a major three-year Alvey-funded research project in the Departments of Photogrammetry and Surveying and Computer Science. The project will involve the design of a parallel machine for the 'real-time' computation of dense range maps.

Applications include mapping from the SPOT satellite and Large Format Cameras and industrial inspection and measurement.

Computing resources include four SUN-3 workstations and a variety of raster and vector digitisation equipment as well as high-speed networking to transporter-based machines at the Alvey consortium partners.

A number of posts are available, funded by the Alvey Directorate through SERC. All involve close collaboration with our Alvey partners.

Candidates should preferably be postdoctoral or have relevant industrial experience. Salaries on Scale RA (1A), in the range £9317-£14 077 (incl. London Allowance).

Department of Photogrammetry and Surveying

We seek three staff with experience ideally in one or more of the following areas: 2.5D ranging sensors and/or techniques, 2.5D (surface & volumetric) CAD modelling, map/image matching, sensor geometry.

Department of Computer Science

We seek up to three staff with experience ideally in one or more of the following areas: algorithms, machine architectures, networking.

Closing date for applications: 9th May, 1986

Please send three copies of your CV, including names and addresses of three referees, to the Departmental Secretary, Department of Photogrammetry and Surveying, University College London, Gower Street, London WC1E 6BT from whom additional information can be obtained.

Informal enquiries may be made to Dr Peter Muller (Technical Project Manager) Tel (01)-380-0453 or JANET: muller@uk.ac.uct

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

Directorate of Fisheries Research, Lowestoft

Atmospheric Monitoring

...you will manage the Atmospheric Monitoring Programme for the deposition of particulate radioactive material.

The work involves the use of appropriate collecting systems and the development of more advanced collection and measurement techniques. The appointment involves considerable field work and liaison with nuclear site operators as well as a commitment to work at sea on research vessels.

You should have a good honours degree or equivalent in physics, chemistry or other relevant science and at least 2 years' post-graduate experience.

Appointment as Higher Scientific Officer: £7785-£10,540 (under review). Starting salary according to qualifications and experience.

For further details and an application form (to be returned by 16 May 1986) write to Civil Service Commission, Alencor Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 468551 (answering service operates outside office hours). Please quote ref: SB/11/AD.

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INFORMATION SCIENTIST

SATRA, Europe's largest Footwear Research organisation provides research, technical and management services to its international membership. Its Information Centre and Technical Library has a comprehensive intake of journals and reports and has developed computer search facilities. We now require an Information Scientist to select and index technical and business information for input to an in-hour information retrieval system.

Applicants should have a science degree, preferably with a further library or information science qualification. Any experience in building and maintaining computerised retrieval systems would be particularly relevant.

Starting salary will depend on qualifications, age and experience. Other benefits include flexible working hours, subsidised dining room, non-contributory pension scheme and an active sports and social club.

Applications in writing to:

Mr C. W. J. Foot
Head of Administration Department
SATRA Footwear Technology Centre
SATRA House
Rockingham Road
Kettering
Northants
NN16 9JH

Hygiene Product Development Research Scientist with creative & entrepreneurial flair

Are you a self-starter, able to grasp responsibility when offered?

If so, we would like to hear from you. These attributes are just what we seek in the individual to assist us in the further development of our world famous oral hygiene and baby care hygiene products throughout the Europe/Africa Division.

We see the ideal candidate as being between 25-35 with a good Science background, having the personality and ability to communicate well in both Scientific and Marketing spheres and free to travel frequently throughout Europe. R&D experience would be an additional advantage.

The salary and benefits package is attractive and offers assistance with relocation, where applicable. For further information and application form contact Joanne West, Personnel Officer, Richardson-Vicks Ltd., Rusham Park, Whitehall Lane, Egham, Surrey TW20 9NW. Tel: Egham (0784) 34422.



Richardson-Vicks

Director Quality Assurance

Huntingdon Research Centre Ltd., has for over thirty years served the needs of the world's major pharmaceutical and chemical industries as an independent contract laboratory specialising in safety evaluation of a high quality.

A vacancy now exists for the important post of Director of Quality Assurance to head up a large and experienced team. Reporting to the Managing Director, the incumbent's major responsibility is to devise, monitor and maintain Quality Assurance programmes such that our Company Management, clients and the world's regulatory authorities are assured that our safety evaluation work is planned, conducted and reported to the highest standards and

is in compliance with Good Laboratory Practice.

Applicants should have considerable management experience in a major Quality Assurance unit and should preferably possess a postgraduate qualification in the biological science or medicine.

We offer an attractive salary, company car and excellent benefits, including relocation help if required. The Centre is located in pleasant countryside with excellent road and rail links to Cambridge, London and the Midlands.

Please send a detailed curriculum vitae to the Director Human Resources & Administration, Huntingdon Research Centre Ltd., Huntingdon, Cambs., PE18 6ES.

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HRC

UNIVERSITY OF WARWICK

LECTURER IN SEMICONDUCTOR PHYSICS

The University is expanding its teaching and research in Electronics. Prof Evan Parker has recently been appointed to build up a group growing 60/80 Ge and InAs/GaAs structures using Molecular Beam Epitaxy in the Physics Department as a major part of this development. Applications are invited for a lectureship in the Physics Department. The person appointed will be expected to undertake experimental investigations of semiconductors layer structures.

The appointment is available at any point on the lecturer scale £8020-£15 700 pa. (under review) and is tenable from 1 October, 1986.

Further particulars and application forms are available from the Registrar, University of Warwick, Coventry CV4 7AL quoting Ref No 40/2A/86/F (please mark clearly on envelope). Closing date 18 May, 1986.

ARCHIVIST

Wilmslow, Cheshire

The success of our Toxicology Unit depends in no small way on the efficient supervision of our archives and library facilities.

For this position, we are looking for a person with a graduate or equivalent academic background, with some experience in librarianship or information science. Ideally you can also offer some knowledge of the biological sciences and GLP as applied to our industry, though suitable training can be given.

The position arises due to maternity and is temporary at this stage, but in all probability it will be made permanent later. Full relocation expenses are not therefore available, though some assistance with short-term accommodation could be considered. Please apply in writing, explaining how you meet our requirements, to:

F. Silvester, Senior Personnel Officer, Chas-Coley Pharmaceuticals, Hardfield, Industrial Estate, Macclesfield, Cheshire SK10 2LY.

NORTH STAFFORDSHIRE POLYTECHNIC

Department of Mining Engineering
RESEARCH ASSISTANT—
COAL LIQUEFACTION

£5541-£6324 pa

This position is supported by an NCB/SERC research grant for research into the conversion of coal into oil. Candidates should have a degree in a relevant subject and should have a good chemical background. Experience of working with nuclear magnetic resonance spectroscopy and of using autoclaves would be an advantage.

Application forms and further particulars are obtainable from the Personnel Section, North Staffordshire Polytechnic, College Road, Stoke on Trent, Staffs ST4 2DE. Tel: Stoke on Trent 45531 Ext 211. Closing date 8 May, 1986.

UNIVERSITY OF OXFORD IVEAGH PROFESSORSHIP OF MICROBIOLOGY

The electors intend to proceed to an election to the Ivesagh Professorship of Microbiology which falls vacant on the retirement of Prof J. Mandiastam on 30 September, 1987. The stipend of the professorship is at present £21 875 pa.

Applications (ten copies, or one from overseas) naming three referees but without testimonials, should be received not later than 19 May, 1986 (27 May, 1986 from overseas) by the Registrar, University Offices, Wellington Square, Oxford OX1 2JD, from whom further particulars may be obtained.

Pharmaceutical Services Scientist

Pharmaceutical Products

Based in an attractive part of rural Buckinghamshire, Ortho-Cilag is an established pharmaceutical manufacturing and marketing company within the International Johnson & Johnson health-care group.

We now have a vacancy within our Pharmaceutical Services Department for someone to become involved with the administrative and evaluative aspects of our product development, scale-up and validation. Specific areas of interest will include the preparation of clinical trials supplies, stability study projects, new manufacturing techniques and documentation.

Candidates should be graduates (or equivalent) in either chemistry, pharmacy or biology, and have experience in pharmaceutical manufacturing or analysis with a sound grounding in the principles of GMP and GLP. Further experience in the areas of pharmacy dispensing, micro-processor operation or BASIC programming would be an advantage. A valid driving licence is essential.

A very competitive remuneration package will be offered consisting of an attractive starting salary and a range of large-company benefits.

For an application form please ring or write to: Mrs J Mackinson, Ortho-Cilag Pharmaceutical Limited, PO Box 79, Sanderton, High Wycombe, Bucks HP14 4HJ. Telephone: Naphill (024 024) 3541.



ORTHO-CILAG
PHARMACEUTICAL LIMITED

NDT/ INSTRUMENTATION DEVELOPMENT ENGINEERS

South Manchester
£8,500 - £18,300 per annum

The Central Electricity Generating Board invites applications from Scientists and Engineers to join the Non Destructive Testing Applications Centre, Wythenshawe. The Centre provides a national service within CEBG for the provision of inspection of the Board's plant to ensure the absence of potentially damaging defects. A wide range of methods are used with an emphasis on ultrasonic inspection.

The successful candidate will join a Group within the Instrumentation Section of the Centre, providing consultancy on automated ultrasonic inspection to the Sizewell 'B' PWR project. The Group provides advice on all aspects of automated inspection from principles to practical application. The advice is based on a programme of R&D into automated inspection systems being carried out both by the Group itself and within the rest of the Centre.

Applicants should have a good honours degree in a relevant scientific or engineering discipline. A knowledge of ultrasonic inspection is desirable.

Starting salary will be in the range £8,500 to £18,300 per annum depending on qualifications and experience etc. The NDTAC is based at the CEBG's laboratories in South Manchester with easy access to a wide range of housing on the fringe of the Cheshire countryside.

Application forms may be obtained from the Personnel Department, CEBG, Europa House, Bird Hill Lane, Cheshire Heath, Stockport, Cheshire, SK3 0XA (061-428 0711 ext. 2571). Completed forms should be returned to the Personnel Manager at the above address to arrive not later than 12th May 1986. Please quote Vacancy Number 3.

The CEBG is an Equal Opportunities Employer.



UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Agricultural
Biochemistry and Nutrition

JUNIOR RESEARCH ASSOCIATE

A Junior Research Associate is required for an AFRC-funded project investigating the molecular biology of Lactic acid bacteria used in the ensilage process. Much of the work will utilise modern recombinant DNA methodology. Candidates should have or expect to obtain a first or upper second class Honours degree in Biochemistry, Microbiology or related discipline. The successful candidate will be expected to register for a higher degree.

The appointment is tenable for three years. Salary will be at an appropriate point on the Range 1B salary scale: £7055-£9495 according to age, qualifications and experience.

Applications (including the names and addresses of three referees) should be sent to Dr H. J. Gilbert, Department of Agricultural Biochemistry and Nutrition, Agriculture Building, The University, Newcastle upon Tyne NE1 7RU, (Tel 0632-329511, Ext 4551) to arrive not later than 8 May, 1986.

The Open University

Faculty of Science

RESEARCH FELLOW IN PHYSICS

Inverse scattering of Nuclear Physics

Applications are invited for an SERC funded research post with a small group involved in the theory and phenomenology of nuclear direct reactions. The successful candidate will work on the extension of recently developed inverse scattering procedures and the application of these procedures to the understanding of nuclear reactions.

Applicants should hold a PhD or equivalent qualification and have experience in most of the following areas: quantum scattering theory, nuclear reaction phenomenology, Fortran programming, numerical analysis. Also useful would be an interest in the general areas of error reduction, statistics or a previous knowledge of inverse problems. Experimental nuclear physicists with an inclination to theory are encouraged to apply. The post is available for two years from a date to be agreed. Salary will be on the 1A (Research Fellow) scale for Research and Analogous staff (£8020-£12 780 pa under review). Starting salary will depend on age and experience but is subject to a probable maximum of £9880 pa.

Application forms and further particulars are available from Dr J. W. R. Smith (7006/2), Administrative Assistant (Science), Faculty of Science, The Open University, Walton Hall, Milton Keynes MK7 6AA, or telephone Milton Keynes (0908) 653993: there is a 24 hour answering service on 653868.

Closing date for applications: 16 May, 1986.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (University of London)

POSTDOCTORAL RESEARCH ASSISTANT FOR RESEARCH ON TURBULENT FLOW

required in the Department of Aeronautics. Applicants must have or expect shortly to obtain a PhD or have about three years relevant PG experience.

The research, supported by external contract, involves numerical solution of the Navier-Stokes equations with particular application to 'large eddy' simulations of turbulence. It forms part of the programme of a group of about ten people working on experimental and theoretical aspects of turbulence, and vacancies for experiments are expected shortly. The successful candidate would be encouraged to interact with other projects within the group.

The appointment is initially for one year. Salary in the range £7055-£9495 or £8020-£12 780 depending on qualifications and experience, plus £1287 LA.

Application with cv to Professor P. Bradshaw, Department of Aeronautics, Imperial College, London SW7 2AZ.

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1886-1986

Upjohn Limited is the UK subsidiary of The Upjohn Company, a major international research-based pharmaceutical company, developing and supplying ethical pharmaceutical and veterinary products worldwide. Within the company's research group, expansion of the Department of Biopharmaceutical Sciences and Drug Metabolism has created vacancies for:

Senior Technical Assistant (GC and MS)

Applications are invited from technicians/graduates with at least five years' practical experience in the fields of GC and MS, particularly their use in the identification and analysis of drugs in biofluids. The successful applicant will work with a Research Bioanalyst, using and maintaining a Finnigan 4610B quadrupole mass spectrometer, equipped with full data system and accessories (DCI, ISP and FAB) and automated Hewlett Packard GC equipment.

Technical Assistants (2) (HPLC or RIA)

Applications are invited from technically qualified personnel with at least three years practical experience in the field of HPLC or RIA, preferably with an interest in the analysis of compounds in biofluids. Experience in the use and maintenance of modern, automated analytical equipment would be advantageous. The successful applicants will assist research analysts in the development and use of novel bioanalytical procedures for the assay of research compounds in biofluids.

In return, we offer a competitive salary/benefits package, scientific career development and pleasant working environment in modern well-equipped laboratories at Crawley, which is conveniently located near Gatwick Airport with fast access to London and the South Coast.

Please write giving details (cv) of qualifications and experience to Pamela Gelder, Personnel Co-ordinator, Upjohn Limited, Fleming Way, Crawley, West Sussex RH10 2NJ.

Upjohn

UNIVERSITY OF LIVERPOOL Department of Immunology Applications are invited for a POSTDOCTORAL RESEARCH WORKER (1A)

in the Department of Immunology, to work on a Cancer Research Campaign funded project involving the molecular cloning of genes encoding human embryonic antigens. The appointment will be made for up to three years. While some postdoctoral experience of molecular biology would be advantageous, this is not essential. Strong candidates, including those at present completing PhD theses and of diverse background and experience are encouraged to apply. There is specific funding available to send the appointee on an appropriate training course in molecular biological techniques.

Initial salary will be within the range £8020-£9495 pa.

Applications, together with the names of three referees, should be received not later than 9th May, 1986, by The Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained.

Quote ref. RV/724/NS.



Royal Military College of Science
Shrivenham

RESEARCH OFFICER-MHD POWER GENERATION

A vacancy has arisen in the Mathematics and Ballistics group for a research officer to assist in a feasibility study of a magnetohydrodynamic power generator. The project is concerned with the extraction of electrical power from high velocity gas flows, and the research will involve the design, assembly and instrumentation of suitable test rigs.

Applications are invited from graduates in physics or engineering, with at least two years relevant experience, or those with equivalent qualifications and expertise. Preference will be given to candidates with experience in one or more of the areas of power generation, engine design, high energy gas flows.

The appointment will be made initially for two years. Salary in the range £7055-£10 375 pa according to qualifications and experience.

Application forms are available from the Personnel Office, HQ RMCS Shrivenham, Swindon, Wilts SN6 8LA. Tel (0793) 782551. Ext 2421/2403 quoting Ref MM8/86.

Closing date: 15 May, 1986.

Cranfield

INSTITUTE OF FOOD RESEARCH BRISTOL LABORATORY

We are seeking to fill a vacancy as LEADER OF THE STATISTICS GROUP at Higher Scientific Officer/Senior Scientific Officer level.

The main responsibilities of this post will be to:

1. Lead the Statistics section in its task of providing an effective and forward looking consultancy service to project leaders. This will include liaison with statistics sections at IFR, Norwich & Reading to ensure that a co-ordinated and non-duplicative service is offered to Food Research Projects.
2. Initiate, carry out and supervise research on novel statistical methodology for use in Food Research and chemometric applications.

The successful candidate will be able to communicate complex statistical concepts to scientists and develop practical solutions to problems in design, optimization and multivariate analysis.

Salary: £7788-£12 653 according to appointed grade.

Qualifications:

At Higher Scientific Officer level a first or upper second class degree in statistics or related science is required. At least two years relevant post qualifying experience in sensory analysis will be needed.

For entry at the Senior Scientific Officer level 4 years relevant experience is required and a PhD would be preferred.

Please send cv quoting reference 85/49 to:-

Personnel Officer, AFRC Institute of Food Research, Bristol Laboratory, Langford, Bristol BS18 7DY. Closing date will be two weeks after the appearance of this advertisement.

BLOND McINDOE CENTRE

Queen Victoria Hospital
East Grinstead, Sussex RH19 3DZ
POSTDOCTORAL RESEARCH
SCIENTIST

Applications are invited for a four year post in the newly established recombinant DNA Laboratory at the Centre. The work covers mRNA and genomic studies of human leucocyte membrane glycoproteins and certain aspects of the human and rodent major histocompatibility complex. Applicants should have a PhD or expect to obtain the degree in the near future. Experience in recombinant DNA work is desirable, but not essential, as the successful applicant could undergo a period of training. Starting salary is negotiable in the region of £9500 pa. Applicants should send a cv and the names of two referees to Professor J. Fabre at the above address.

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Applications are invited from suitably qualified candidates with academic or industrial experience for a Lectureship in Physics within the Department of Geology and Physical Sciences. There is a possibility that a second post will be available. The Department is seeking to strengthen its teaching and expertise in the areas of solid state physics, microelectronics, digital signal processing and optoelectronics. Active research areas within the Department include the physics of thin-films and surface coatings, quantitative electron microscopy, biosensor development, solar energy conversion and laser-doppler instrumentation for blood flow measurements. Candidates should demonstrate the ability to undertake and supervise research and continue development of industrial links.

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Deadline for applications: 9 May, 1986

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Projects

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The job also requires preparation of draft specifications, work programmes, reports and presentational material. A knowledge of computer applications is desirable, but a lively and enquiring mind is essential.

A current driving licence is required as the post carries an essential user allowance.

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Assistance with relocation expenses will be given in appropriate cases.

For an application form please write to: The Personnel Officer, Rivers Division, Room 501, Nugent House, Varsity Road, Reading RG1 8DB or ring Reading 595457 quoting Reference TS/A/6.

CLOSING DATE: 9 MAY, 1986.



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We have a vacancy for a graduate or post-graduate chemist in our Analytical Laboratory. The successful candidate will be required to carry out research and to develop and adapt analytical methods relevant to the activities of the Research Association.

Whilst the determination of trace constituents, including vitamins and residues derived from additives and contaminants, will form part of the work, the main emphasis will be on cereal-based ingredients and products. Relevant experience, especially of modern analytical techniques, is essential.

Starting salary will be in the range £7800-£9500. Applications, including a full cv, should be sent to The Secretary, FMBRA, Chorleywood, Herts. WD3 5SH by 8 May, 1986.

Pharmacologist

The department of drug discovery at Hoechst, Milton Keynes, has a vacancy for a Pharmacologist within their Biological Research Group. The successful candidate would be part of a small team engaged in the *in vivo* evaluation of the new chemical entities derived from a recently established anti-rheumatic project. There will be the opportunity to undertake collective studies with other scientists from related disciplines, also involved in biological research.

The position requires a PhD with 1 to 3 years' post-doctoral experience, ideally in the field of inflammation. In addition some experience of the pharmaceutical industry would be an advantage, but not essential.

The company offer a competitive salary and package of benefits including a contributory pension scheme with life insurance, free membership of PPP for employee and family, a system of flexible working hours and excellent sporting and social facilities. The site is in a rural area at the edge of the city of Milton Keynes where housing is readily available for purchase or rent. There is a generous relocation allowance for anybody who has to move into the district.

Please write or telephone for an application form, to: Beryl Russell, Personnel Department, Hoechst UK Limited, Walton Manor, Walton, Milton Keynes, Bucks MK7 7AJ.

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THE UNIVERSITY OF LEEDS

DEPARTMENTS OF ANIMAL
PHYSIOLOGY AND NUTRITION
AND OBSTETRICS AND
GYNAECOLOGY

POSTDOCTORAL RESEARCH FELLOW

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A good honours degree in Biochemistry and a PhD together with experience in measurement of parathyroid hormone, calcitonin and Vitamin D metabolites are required.

Post from October 1986 for a fixed period of two years.

Salary on the 1A range for Research and Analogous Staff (£8020-£12 780) (under review) according to age, qualifications and experience.

Informal enquiries may be made to Mr D. W. Purdie, Department of Obstetrics and Gynaecology (Tel 0532) 432799 Ext 3869.

Application forms and further particulars may be obtained from and completed applications sent to the Registrar, the University, Leeds LS2 9JT, quoting reference number 61/27. Closing date for applications 15 May, 1986.

NATURE CONSERVANCY COUNCIL

NCC—Temporary Scientific Vacancies Concerned with Peatlands

The NCC has vacancies for three short term appointments:

- 1. Scientific Officer**—to assist with a peatland survey programme. The successful applicant will be based in Peterborough but during the field season will be required to undertake field work in Northern Scotland, sometimes under extremely arduous conditions. Detailed site reports of sites visited will be required after the end of the field season. This post requires a proven competence in vegetation survey, preferably on peatland habitats, and expertise in Sphagnum taxonomy would be advantageous. Applicants should have a science-based degree. The employment will last until March 1987. A current driving licence would be an advantage. Salary range: £6190-£8561.
- 2. Scientific Officer—Vegetation Survey.** The successful applicant will be based at home but will spend several two week periods in Northern Scotland. The production of site reports will be required. The employment will be for approximately four months. Applicants should have a scientific-based degree. Salary range: £6190-£8561.
- 3. Higher Scientific Officer—Bibliography/Site Management** Part of this work entails updating and adding to an existing computerised peatland bibliography. The remainder of the time will involve a review of peatland management on sites throughout the country. This will involve site visits. The successful applicant would produce a peatland management handbook. The post is based in Peterborough and applicants should have a science-based degree and at least two years relevant postgraduate experience. Employment will last until March 1987. Salary range: £7788-£10 541.

Application forms and further details are available by telephone on Peterborough (0733) 40345, Ext 214. Closing date for completed application forms is 9 May, 1986.

The Nature Conservancy Council is an Equal Opportunities Employer.

UNIVERSITY OF BATH School of Biological Sciences TECHNICIAN

A vacancy exists initially for six months to cover maternity leave, for a technician in the horticultural sciences laboratories. Duties will include the preparation of materials and equipment for undergraduate practical classes, the operation and maintenance of basic laboratory instruments and research equipment, and assistance with postgraduate student projects, particularly those involving plant tissue culture techniques.

Applicants must be qualified to at least ONC or equivalent in Chemistry or Biochemistry and have some laboratory experience.

Salary in the range £5683-£6667 pa (under review) according to qualifications and experience.

Applications forms from the Personnel Officer, University of Bath, Bath BA2 7AY, quoting reference number 86/63.

Closing date 8 May, 1986.

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University College of North Wales

Research Fellow/Senior Research Fellow

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Further details and application form from The District Personnel Officer, Gwynedd Health Authority, Ceredigion, Bangor, Gwynedd LL57 4TP. Tel (0248) 331551 Ext 277. Closing date 19 May, 1986. The Authority operates a bilingual Recruitment Policy.

BIRKBECK COLLEGE

Department of Crystallography

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are available in the Liquids and Disordered Systems Laboratory. There are openings in interdisciplinary projects relating largely to the role of solvent in the operation of biomolecular processes, using a variety of experimental and theoretical techniques including neutron and x-ray scattering, computer simulation and spectroscopy. Enquiries are invited from interested physicists, chemists, computer scientists and biologists who hold, or expect to obtain this year, a first or upper second class honours degree.

Further details from Professor J. L. Finney, Department of Crystallography, Birkbeck College, Malet Street, London WC1E 7HX. Tel. 01-580 6622, Ext 6284.

INSTITUTE OF NEUROLOGY

Department of Neurochemistry
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Applications with cv and names of two referees to Professor G. Curzon, 33 John's Mews, London WC1N 2NS.

newscientist

Vol 110 No 1505 24 April 1986

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Holborn Publishing Group

Commonwealth House

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London WC1A 1NG

Tel: 01-404 6700

Subscription inquiries: 0444 459 188

Telex: 915748 MAGDIV G

Dialcom/Telecom Gold Box 83-NSM005

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Coming clean

LAST WEEK the British government announced proposals to open the door a little wider on public access to information on pollution. This move followed an interdepartmental working party which concluded that the flow of information could be improved by a mixture of exhortation and legislative tinkering.

Legislation is now promised to enable Whitehall to reveal details of the authorisations for the disposal of radioactive waste. This will end the present farce which allows the government, its pollution watchdogs and the producers of radioactive waste to hide behind the catch-all provisions of sub section 13(3) of the Radioactive Substances Act 1960. This makes it an offence to disclose information without prior consent of the parties involved.

Plainly, such draconian provisions are a public relations embarrassment at a time when the government is anxious to assuage public concern over the prospect of a new generation of radioactive waste dumps. Sensibly, ministers are now committed to act, though in practice it will be next year before the good intentions can be turned into fact—such are the exigencies of the parliamentary programme. In addition there are plans to offer more information on air pollution and what waste is dumped in land tips. So far so good.

The fact remains, though, that progress overall remains haphazard and grudging. There are a number of anomalies.

In many instances these anomalies reflect the traditional "cosy" nature of much pollution policing in Britain. This has the industry and the regulatory authorities engaged in a dialogue to which the public is rarely invited or privy. The unwritten assumption is clear. Pollution control is a matter for the experts, not for lay people.

Thus, despite the ringing imperative from the Royal Commission on Environmental Pollution that local authorities should publish information they collect on air pollution from the factories they

inspect, the civil servants have recommended that the government should hold back from taking action. Part of the rationale for this reluctance is the civil servants' fear that the exercise could be counterproductive. "Care must be taken to ensure that any further disclosures should be within carefully defined parameters clearly understood by industry so that it does not reduce the flow of information produced by industry." That sort of blandishment contrasts sharply with the philosophy the government is meant to espouse, namely unrestricted access unless there are genuine reasons for withholding. The needs of national security and commercial confidentiality are the only exceptions.

Despite Whitehall's posturing on this subject, there is still no direct access to reviews of the safety of civil nuclear power stations, test results from new car engines or open publication of the scientific evidence on the hazards of pesticides approved up to last year.

Earlier this month new legislation came into force which expressly ensures public access to background reports and data assembled by local authorities as part of policy making and in their role as pollution control authorities. Unfortunately the government has not showed a similar interest in opening up its books. What is politically good for town halls is not suitable for Whitehall, evidently.

At the moment ministers have proposed brand new authorisations for radioactive discharges from the British Nuclear Fuels plant at Sellafield. The proposals were put to BNf weeks ago. No one is prepared to discuss the details. Cosy isn't it? If the government really is committed to greater openness, it really ought to come clean.

Unfortunately, continued dragging of feet is only to be expected. After all, it took a staggering 11 years for Whitehall to implement the section of the 1974 Control of Pollution Act which brought into play the Water Authority system of public registers containing details about effluents and monitoring. □

Off the shelf

LIBRARIANS don't have a reputation for complaining. But that could change as more and more librarians begin to realise what is going on at the British Library. The problem is, as usual, that budgets are not keeping pace with inflation. The budget for the British Library in 1986/87 is £49 200 000, just 2 per cent more than for the previous year, £2 million less than requested and something like 3 per cent less than the library would need to stand still.

The fate of the British Library is important for one fundamental reason—it is the focus for many libraries in institutions not just around Britain but around the world. A pound spent on the British Library is, therefore, a pound spent for hundreds of libraries, many of which are themselves suffering from shrinking budgets. Libraries in universities, government establishments and industry are constantly looking at what is available

centrally so that they can save on their own acquisitions bills. Such libraries also turn to the British Library for specialist material, journals and reports in Japanese, for example.

The British Library has, so far, managed not to harm its archive of scientific and technical material. It is trying to make better use of its material by, for example, holding common stock for its lending and reference divisions. But if the cuts continue it will have to make difficult decisions—it will have to cancel its subscriptions to some journals. And as any publisher or librarian will confirm, it isn't always easy to fill gaps at a later date.

There is always a fine balance to strike between acquiring new stocks and preserving existing material. So far the British Library has managed to avoid the worst effects of its declining budget by such expedients as postponing maintenance work. It cannot carry on doing this for ever. □

THIS WEEK

CIA 'spies on British computer firms'

Steve Connor

THE US Embassy in London has denied that the CIA is checking that British computer companies do not export American technology to communist countries. The suggestion that the US government has told the CIA to spy on British companies is made by Liberal MPs. They have called this week for a debate in the House of Commons. Their motion condemns the US for wanting "effective control of over 70 per cent of all high technology and computer trade in the UK".

The claims came in the week that new export regulations, come into full effect in the US. These laws set strict rules for American companies with special distribution licences that enable them to export sensitive technology to British companies. The American firms must check that these companies do not re-export the technology to the East.

In order for this to be done, the US wants to send officials to Britain to carry out special "audits" of British companies. The US embassy says that it has asked for the British government's approval for such audits to take place but has not as yet received a reply.

Meanwhile, according to the Liberal MP Paddy Ashdown, the US government has empowered the CIA to "police end users in Europe and the UK for compliance with the US regulations". He has come to this conclusion after seeing a document called the Federal Register, which outlines the US export regulations.

The US embassy, however, denies that the CIA is charged with the task of policing these export controls. A spokesman for the embassy said that these laws are enforced by the US Customs and the Department of Commerce. "The CIA has no role in this business at all," he said.

According to a spokeswoman for the Department of Trade and Industry (DTI),



Ashdown

digital

Ashdown says the US controls computer trade in Britain. When Digital stuck to the rules, 1000 jobs were lost

the "CIA element is a new factor to us". The department is aware of the US's request to conduct audits of British companies, and if the "US government decides it will be the CIA that conducts these then that is up to them", she said. The DTI has still not made up its mind over the request, she said, even though it was made some months ago. This, she admitted, is an unusually long time to deliberate over the issue.

Two American companies with special distribution licences, IBM and Digital Equipment (DEC), have taken care not to infringe the regulations.

IBM told its customers in 1983 that the US's export regulations affect transactions

"within the UK". Such transactions "include not only the initial installation of a new machine with a user, but also any subsequent dealings or transfers in such machines."

In a briefing document to its staff, DEC points out that if it loses its distribution licence it will have to apply for individual licences each time it wants to sell computers abroad: "The distribution licence is very important to DEC," the company says. "Without a [licence]... our business would come to a standstill."

Another Liberal MP, Michael Meadowcroft, alleges that DEC's over-zealous attitude towards enforcing the terms of the licence helped to play a part in the downfall of a British computer company, Systime, which bought and then resold DEC equipment. He says that interference in British sovereignty has caused the loss of more than 1000 jobs at Systime. In the briefing to its staff, DEC makes no secret that the company "must control the movement of the hardware, and software and know-how in the UK to ensure that DEC remains within US and UK laws". The Attorney General, Sir Michael Havers, has said that such controls are an unwarranted interference in British sovereignty. □

German press reveals SDI trade deal

A WEST German newspaper has published details of a secret agreement between the US and West Germany. The agreement allows German participation in the Strategic Defense Initiative (SDI) in return for a clampdown on exports of "sensitive" technology from West Germany to the Eastern bloc. (*New Scientist*, 27 March, p 12).

German companies fear that the leak will jeopardise their chances of winning SDI research contracts.

A newspaper in Cologne published the agreement, which was signed last month by the German economic minister, Martin Bangemann. It also published an exchange of letters between the chief German negotiator for SDI, Lorenz Schomerus, and Richard Perle from the SDI office in the US. The publication came last Friday—the day after the West German parliament discussed the agreement in secret session.

Siegfried Mann, head of the Association of German Industry, said the revelation will hurt German interests. General Franz-Joseph Schultz, the former head of NATO's middle-European strike force, said: "If we can't even keep the agreement a secret, the Americans will wonder how we'll do with the other things, and whether cooperation is possible."

Security was a preoccupation of the agreement. It guarantees that the US "insofar as law, national policy and international commitments permit", will apply the same conditions to SDI contracts

awarded to German as to American firms. The US government promises to share information relevant to SDI projects with German companies to allow them to bid on equal terms for contracts.

Both governments promise to take all



German Embassy

Bangemann: signing away economic Ostpolitik

possible steps "to prevent transfer of sensitive SDI technology to forbidden destinations". Classified technical data and computer software developed or exchanged under the agreement are singled out, with each government agreeing that it should be responsible for preventing "unauthorised publication".

The US Department of Defense is to give instructions with each contract on what is or is not classified. But, "as a contribution to this desired security, information that one government has given the other [such as the agreement itself] is designated as secret", says the agreement. ▶

OBSERVER David Austin

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► The governments guarantee that, so far as laws, US policy, "security interests" and proprietary rights allow, any non-classified results from SDI research can be applied to non-military aims. The governments also say they will exchange information in several agreed areas of SDI research, specifically any "considered useful for the improvement of conventional defences, especially air defence."

The unwritten part of the agreement is revealed by letters sent to Schomerus by Perle. They ask what measures the West Germans "intend to take to strengthen domestic control over the export of sensitive technology".

Specifically, Perle asked if the Germans intended to change their law to make illegal the transfer of any technology that is proscribed by COCOM, the 16-nation coordinating committee on trade with the East. He asked if penalties for breaking export laws would be sharpened, if the staff enforcing export controls would be increased, and if the two countries could hold regular consultations on technology exports.

In a letter dated 27 March 1986, the day the SDI agreement was finally signed, Schomerus was able to assure Perle that his government would increase its supervision of the movements of embargoed goods within West Germany. German merchants will need authorisation to sell restricted technology to certain foreigners, including staff at foreign embassies.

The law for transporting restricted goods will also be changed, said Schomerus. Penalties for breaking export-control laws will be increased, and the burden of proof may also be shifted to the accused. Enforcement staff will be increased. Schomerus said COCOM should become "a more effective instrument . . . [with] daily cooperation among members".

The terms of the agreement concern many West German industrialists, who have seen an impressive rise in trade with the Soviet Union during the past four years.

In the past few weeks, two contracts which concerned COCOM's secretariat were concluded. One, worth about £200 million, was for work on the Siberian gas pipeline. A second, for building a plant to make polyesters, was worth about £2800 million.

The Americans are clearly overjoyed that the West German government has signed. Both economically and strategically, West Germany was the key European country to be counted for the SDI project. It is likely to encourage other countries to follow.

The signing is undoubtedly an important step in isolating the Soviet Union scientifically and economically. A commentary on the agreement by the Soviet news agency Tass sharply criticised the West Germans for signing. But the Soviet Union is likely to continue to offer lucrative contracts to West German industry, including those which would conflict with the technology-transfer provisions in the agreement.

West German industry will find it very hard to resist the opportunities offered by the economic expansion of Siberia in particular, despite the fact that almost every project in this area would involve the exchange of sensitive technology. □

Titan explosion disrupts sky spies

THE US space programme, already reeling from the loss of the Challenger last January, was dealt another blow last Friday when a Titan 34D rocket exploded shortly after launch at Vandenberg Air Force Base in California. It is the second time a 34D rocket has exploded in eight months.

Both rockets were believed to be carrying



The Titan blast showers debris over California

a sophisticated spy satellite called a KH-11. The satellite can view from space objects no larger than a car licence plate. Military observers said this week that the US only had one KH-11 deployed in space and that it would run out of power within a year.

"It's a real crisis," said Paul Stares from the Brookings Institution in Washington. "This will create major problems in the photographic reconnaissance programme, and in our confidence in monitoring Soviet military activities at a critical time," he said. The Titans were also to be used to launch satellites and experiments as part of the Strategic Defense Initiative.

The Missile Mischap Board has begun an investigation into the latest explosion. Its report is expected within four to eight weeks.

The solid fuel rockets and the rubber sealant O-rings—both under suspicion in the shuttle explosion—will be closely examined for failure. Maj. Gen. Jack Watkins, commander of the 1st Strategic Aerospace Division, said that sabotage could not be ruled out as a possible cause. "We will be looking at everything."

The Titan, launched from Space Launch Complex Four at Vandenberg, was about 350 metres in the air when it exploded. Debris showered the base and a toxic cloud formed. The cloud, visible for about 75 kilometres, contained dimethylhydrazine and nitrogen tetroxide, two toxins in the rocket propellant. Doctors examined 74 people for possible exposure to the cloud and two were kept in hospital for observation. The cloud rose to

about 2 kilometres. The other Titan 34D rocket exploded on 28 August last year, two minutes into the flight. The 34D is a vastly modernised version of the Titan rockets that were once the mainstay of US inter-continental nuclear weaponry. □

Dry store proposed for nuclear fuel

PLANS for a central dry store to hold spent fuel from Britain's nuclear reactors have moved into top gear. An announcement about the project was expected today (Thursday) from the Central Electricity Generating Board. The possibility of building a massive dry store to house irradiated fuel from advanced gas-cooled and pressurised-water reactors was first revealed during the Sizewell B public inquiry (*New Scientist*, 9 February 1984, p 3).

If the plan ultimately gets the go-ahead, the multi-million pound store could be located at Sellafield. The design of the complex—basically a series of air cooled concrete vaults—will require safety clearance from the Nuclear Installations Inspectorate.

The store would allow the fuel to be stored for up to 100 years without being reprocessed. But ironically, the board was last week preparing to reveal its latest moves over the dry store at the same time as it finally signed a contract to make use of British Nuclear Fuels latest reprocessing facility, the £2-billion Thermal Oxide Reprocessing Plant (THORP), now under

construction at Sellafield.

The CEBG has agreed, along with its Scottish counterpart, the South of Scotland Electricity Board, to consign up to 1800 tonnes of spent fuel for handling at Sellafield. The existence of a dry store will leave the CEBG in a stronger position to negotiate future favourable reprocessing deals.

Design work on the dry store, which is modelled on the board's existing smaller store at a nuclear station at Wylfa in north Wales, has so far cost well over £2 million. The design envisages a concrete blockhouse that could grow to become half a kilometre long.

● The CEBG was at the centre of a row this week over plans to build a pilot plant for treating radioactive sludges at its Magnox nuclear power station at Dungeness in Kent. It wants to clear a backlog of short-life intermediate level waste there—chiefly the magnesium 'cans' stripped from spent fuel assemblies (*New Scientist*, April 11 1985, p 28). Environmentalists claim the scheme is a way of side-stepping the current ban by trade unions on the disposal of radioactive waste at sea. □

Genes at work



Voluntary guidelines will control gene experiments

SCIENTISTS in Britain who want to release genetically engineered organisms into the environment now have a set of official guidelines to work to. But the guidelines, which are published this week by the Health and Safety Executive, are voluntary. And the companies or organisations that approach the executive can request that the details of their experiments remain secret.

The guidelines put the onus on the scientists to assess the risk of their own proposals to release engineered organisms. At present, there is no legislation forbidding the release of altered organisms, except in specific cases, such as micro-organisms that help to control pests. These come under general legislation on the use of pesticides. The guidelines are meant to fill this gap.

The guidelines ask scientists to take into account the nature of the organism involved, including its ability to form struc-

tures that can survive in the open for long periods, and also the nature of the environment into which it will be released. There must be contingency plans in case of "unanticipated effects" of the novel organisms.

The guidelines also ask scientists to pay attention to the chances of the new organisms surviving beyond the intended period of the trial, and the possibility of the organism passing its new engineered trait to other organisms. The Advisory Committee on Genetic Manipulation, which drew up the guidelines for the Health and Safety Executive, wants to be notified in advance of any proposals to release genetically altered organisms. Although the notification will be voluntary, the committee wants them to become obligatory.

Nevertheless, the committee feels that there is no excuse for it not being told of a proposed release of a novel organism into the environment. The committee says in its guidelines that "all proposals to release genetically manipulated organisms must be notified for its consideration."

The committee also wants other bodies, such as local environmental health officers, to be told about the proposal. However,

there is a clause in the guidelines that permits companies to keep certain commercially sensitive information secret. Maurice Frankel, director of the Campaign for the Freedom of Information, says that this must not be taken to mean that companies can get away with releasing organisms into the environment, and not telling the public that they are doing this. "We would want to challenge the definitions of what constitutes commercially confidential information," he said.

The secretary of the advisory committee, Brian Ager, stresses that the guidelines are not "tablets of stone". It is not yet possible to establish a single, broadly applicable scheme for assessing the risk of releasing novel organisms, he says. For this reason, the committee will consider proposals on a case-by-case basis.

Ager dismisses the suggestion that the rules covering release of altered organisms are less strict in Britain than in the US. Although some American companies have complained that it is easier to perform environmental trials in Europe than in the US, Ager says that he does not foresee Britain becoming a "genetic dustbin" for experiments that cannot be done in the US. □

Europe is deadlocked over fast-breeder's future

FRANCE and West Germany are deadlocked in negotiations over the next step in the development of fast-breeder nuclear reactors in Europe. Electricité de France (EdF), the state electric monopoly is taking advantage of the stalemate to cast doubt on the future of the whole fast-breeder programme. The issue casts a cloud over the current public inquiry in Britain which is considering plans for a reprocessing plant at Dounreay to service the European breeder.

There are two fast-breeder nuclear reactors now in operation on the continent. Phenix and Superphenix. Both are in France. Superphenix, the world's first commercial-scale fast breeder, was started up last September, a year late and costing three times the original estimate of \$550 million.

The 1200-megawatt plant will produce electricity at twice the cost of the light-water reactors that now supply 60 per cent of French electricity. Last Week, Remi Carle of the EdF said that France was regarding the future of fast breeders with renewed caution—especially since the fall in the price of oil.

Other experts say oil prices should have nothing to do with Europe's commitment to fast-breeder technology. Klaus Koerting of the nuclear research centre in Karlsruhe, West Germany, says the fluctuations in oil prices are too short-lived to govern decisions about the next fast-breeders, which will take at least a decade to build.

"Europe should build a new plant every ten years simply to maintain its lead in fast-breeder technology," says Koerting. Independence of energy sources that depend on imported uranium or fossil fuels is, he says, the real argument for fast-breeders, which regenerate their own fuel.

France, Britain and West Germany, in collaboration with Belgium and Holland,



Superphenix: still Europe's biggest breeder

are party to an agreement committing them to developing fast breeders. The question now is how to build the next generation. France and West Germany both have their own ideas, and negotiations formally began at the summit between President Francois Mitterrand and Chancellor Helmut Kohl last year. The other nations are letting them fight it out.

According to sources in the German research ministry, which is leading the German negotiators, the fight is deadlocked. The French would like all the parties to commit themselves now to building the next, 1500-megawatt fast breeder, called SNR-2. Only after that, they say, should details of the design and location be worked out.

German officials say this position is "incomprehensible". Under the agreement, the Germans have to make up for the French having borne most of the costs for Superphenix, by shouldering most of the

cost of SNR-2. German fingers have been burned, however, by their experience with their own 300-megawatt fast-breeder prototype, SNR-300 at Kalkar. They want to work out costs and design in detail before making any commitments.

Kalkar is expected to go critical this year. It is eight years behind schedule and costs have quadrupled, partly because of design changes demanded by the state government in North Rhine-Westphalia.

"If there is one thing we have learned from Kalkar, it is not to go ahead with another fast breeder without full building permission first," say negotiators at the research ministry in Bonn. They want to spend up to five years planning SNR-2. Builders could decide whether to go ahead then, or opt out if costs were excessive.

At meetings last week, companies in the French nuclear building industry are said to have supported the German view. The French atomic energy agency has rejected it, however. The French agency has its own design, which it claims will cut 40 per cent from the costs of Superphenix by eliminating the containment vessel around the reactor. It says such a vessel is no longer necessary to stem the "maximum credible accident".

One way out of the deadlock would be for France to control SNR-2 instead of West Germany. If so, its design, rather than designs now being worked out in Germany, will probably be used.

Meanwhile, at the Dounreay inquiry, the UK Atomic Energy Authority has been stressing the value to Britain of fast-breeders. Harry Allardice, the authority's engineer in charge of the proposed reprocessing plant told the hearing: "We have in store in this country some 20 000 tonnes of depleted uranium which, if used in a fast reactor, is the equivalent of all known coal reserves in this country." □

Hands up for hands-on science

BRITISH science museums are going "interactive". Seven centres at which visitors will be able to play with science exhibits are set to open within the next year.

Part of the reason for this spirit of activity is a fund set up by one of the Sainsbury family trusts—the Fund for the Development of Interactive Technology Centres. Last month, the fund awarded five grants to help set up and evaluate hands-on science.

The Hampshire Technology Centre (HTC) has received £86 550 to build a mobile exhibition, to be followed by a permanent "interactive technology centre" in a disused school in Winchester. The HTC has support from local government, education and industry. Its director, Colin Brookes, is on secondment from IBM. Half of the exhibits will be devoted to technologies that are relevant to local industry.

Brookes wants to provide equipment that schools can borrow and run training courses on modern technology for teachers.

The Welsh Interactive Science and Technology Centre has emerged from the team responsible for the "science weeks" in Cardiff (*New Scientist*, 24 November, 1983, p 585). Professor John Beetlestone believes that many people were repelled by science at school. So the centre will relate science and technology to music and art. It will also concentrate on relatively simple concepts where the effect is manifest, rather than the high-technology side of science.

An £80 000 grant from the Sainsbury fund will allow the Welsh centre to open above a gas showroom in the heart of a shopping centre at the end of this year. The organisers hope that a permanent site will follow.

The National Museums and Galleries on Merseyside houses its technological and scientific collections in a shed at Princes Dock Stores, on Liverpool Pier Head. The collection covers printing presses, hydraulic pumps, telescopes and rockets.

Recently, the museum ran a "technology tested"—20 interactive exhibits to help people understand the physics and engineering underlying the main collections. A grant of £90 000 from the Sainsbury fund will allow a further 30-40 exhibits to be built, and for the tested to open daily this year.

The Nuffield Observatory at Jodrell Bank in Cheshire attracts thousands of people every year to its planetarium and

visitor centre. The centre includes an exhibition on basic astronomy, radio-astronomy and telescopes, and the observatory has received £69 200 from the Sainsbury fund to expand this to include interactive exhibits. Some will demonstrate forces in the Universe, such as gravitational pull and electromagnetism.

In a gallery overlooking the Mark 1 radiotelescope (the second largest steerable telescope in the world), visitors will have a chance to try their hand at interactive exhibits that show how this giant bowl



Launch Pad at the Science Museum

collects radiowaves and concentrates them on one point. Other exhibits in the gallery will show how lightwaves, heat and sound can be reflected, collected and focused.

The final Sainsbury grant is to Wynne Harlen of the School of Education at the University of Liverpool. Her team will evaluate the four projects and their exhibits and look at how children and adults interact with the exhibits and the trained interpreters at the centres.

Other interactive centres opening within the next year are Launch Pad at the Science Museum in London, the Exploratory at Bristol, and an interactive-technology centre at the Manchester Museum of Science and Industry.

Biogen bags another interferon patent

BIOGEN, the biotechnology company, has been awarded a patent for the protein gamma-interferon. This is the first patent to be issued for the product. The patent has been given for its use in treating the crippling joint disease rheumatoid arthritis.

The award will come as a major disappointment to Biogen's Californian competitors, Genentech, which might have expected to be awarded a patent for the synthesis of gamma interferon by genetic engineering. Biogen has done more clinical trials, however, and in conjunction with its German partner, Bioferon, has discovered

that regular injections of gamma interferon help sufferers from rheumatoid arthritis. Biogen already holds the patent rights to alpha-interferon, which was recently launched in Britain.

Gamma interferon has received most attention for its possible role in fighting cancer. Rheumatoid arthritis is a progressive disease affecting a million people in Britain. Gamma interferon probably interferes with the autoimmune process, encouraging the body to destroy tissue that produces rheumatoid arthritis. The doses are much lower than those involved in treating cancer.

Hemp and wallabies

FARMERS anxious to avoid contributing to Europe's mountains and lakes of wheat, beef, sugar beet and milk should consider moving into sheep dairying, fuel crops, flax and hemp, together with rabbit and wallaby farming. Replacing Friesians with marsupials, and cereals with flax are two proposals from a report just published by Reading University's Centre for Agricultural Strategy.

The centre was asked by the Ministry for Agriculture Fisheries and Food to look at alternative enterprises for British farming. One possibility canvassed by the report is the use of crops to produce ethanol either as a replacement for petrol, or as an octane enhancer, to help boost power from lead-free petrol. Both cereal grain and sugar beet could be used.

The cultivation of hemp is currently banned in Britain because it produces marijuana, the well-known stimulant. However the report points out that a "monoecious variety" of hemp is now available in which the psychoactive ingredient of marijuana has been reduced to "virtual insignificance", according to researchers. Hemp could prove a useful substitute for synthetic fibres for carpets.

Walking back to health

BRITONS are walking their way to health, according to figures released by the government's Central Statistical Office. One in five people walk three kilometres or more, at least once a week—an increase of 10 per cent between 1977 and 1983.

The annual London marathon has helped promote a sharp increase in jogging among men—up from 1 per cent of the population in 1977 to 3 per cent in 1983. But cricket is no more popular than it was six years ago, and given England's performance in the West Indies it is unlikely to make any further gains.

This picture of a healthier Britain is confirmed by a modest drop in heart attacks. Ten thousand fewer people died from a heart attack in 1984 than in 1983.

Sulphur dioxide pollution at 3.5 million tonnes in 1984 was well down on the 1974 figure of 5.4 million tonnes. Linked with this drop is a decline in the number of deaths from respiratory diseases, from 89 000 in 1974 to 66 000 in 1984.

Acid rain in Cornwall

RARE species of wild flowers in Cornwall are facing extinction because of acid rain, according to the Cornwall Trust for Nature Conservation (CTNC). In its latest survey of species native to the county, the Trust concludes that "acid rain is upsetting the balance of nature in Cornwall". Cornwall's rain is generally clean, coming off the Atlantic Ocean. But there are occasional severe acid "episodes" when the wind is from the east.

Of the 945 native species surveyed, there was a marked decrease among those that grow on lime-rich soils. Dr Nick Tregenza, author of the survey, believes that these types of plants—known as calcicoles—are unable to cope with the steady acidification of the soil, and are dying out as a result.

"Our findings came as a surprise", he says. "They show clear evidence of a progressive acidification of the soils of Cornwall, a factor which is the principal cause of the extinction, or impending extinction of several plant species. A major factor in this change has been acid rain." Two species of plant that grow on acid soils, bracken and rhododendrons—are spreading rapidly on Cornwall's moors and heathlands, says Tregenza.

The survey lists 33 species that are at risk of extinction. Five varieties spotted in a similar survey in 1980 were not seen this time, and may already have died out in Cornwall. Only "substantial reductions in sulphur dioxide emissions" will halt the decline, says Tregenza.

Frozen eggs find ethical favour in Australia . . .

THE BITTER ethical arguments surrounding the freezing and storage of human embryos may soon be a thing of the past. Australian scientists, the acknowledged world leaders in the technology of *in-vitro* fertilisation, last week unveiled a way to freeze and thaw unfertilised human eggs.

The egg can be thawed, mixed with the partner's sperm, and the embryo inserted into the womb at ovulation without the embryo ever being frozen. The technique has been developed at Flinders Medical Centre in Adelaide, South Australia. Details were published last week in *The Lancet*. The technique has already resulted in one pregnancy in Australia. An Adelaide woman is expecting twins in July.

The scientists have no plans to market the technology. "We're a bit like babes in the wood in Adelaide, I must confess," says the team leader, Warren Jones.

Some scientists in Australia have suggested that the chemicals used to protect the egg while it is being frozen may themselves damage the egg and the subsequent embryo. Alan Trounson, at Monash University's Queen Victoria Medical Centre in Melbourne, wants to test this possibility using human eggs, but has been unable to get permission. The Flinders' scientists say the risk of damage is minimal, however. They have produced more than 200 normal rodent offspring after freezing unfertilised eggs. "The rate of damage is exactly the same as normal mating," Jones says.

The Flinders technique avoids one of the main objections raised by critics of *in-vitro* fertilisation—what to do with the extra eggs

produced when women who have trouble producing eggs are "hyper-stimulated". Until now, the choice has been either to throw the eggs away or to fertilise them and create spare embryos that may one day be destroyed. Critics say that the embryo should not be treated this way.

By freezing the eggs, wastage is

minimised because eggs can be thawed to coincide with the woman's ovulation cycle. Another benefit is that the woman only has to undergo one laparoscopy—the removal of eggs through a tube inserted in the abdomen. So there is less pain involved. There has been much concern about what to do with any unwanted embryos. Now, if a couple change their minds and choose not to have a child, then a frozen egg, and not a frozen embryo, is lost.

Some researchers question the distinction. "It doesn't make much difference whether you freeze eggs or embryos because I don't think the embryo has a moral status different from that of the egg," says Peter Singer, director of the Centre for Human Bioethics at Monash University.

The development at Flinders also raises the possibility of centres for storing eggs, much like sperm banks.

Young women could have eggs removed from their ovaries for use years later, when the risk of chromosomal damage to their offspring would normally be much greater. More women could start to have children outside what is normally regarded as the optimal years for childbirth.

Egg freezing has proved elusive because the technique used for freezing embryos could not be used. The egg is a single cell and liable to rupture. It could not withstand the ice crystallisation that accompanies the freezing of embryos. Also, the egg must be stored at much lower temperatures, -196°C compared with about -80°C for the embryo.

At Flinders, the scientists start by reducing the size of the cell structure around the egg. A cryo-protectant—in this case dimethyl sulphoxide—is used to penetrate the egg to protect it during freezing. After periods of rapid and slow freezing, the egg is stored in liquid nitrogen. It is surrounded by frozen culture medium—"like being embedded in a sheet of glass", says Christopher Chen, the scientist at Flinders who devised the technique.

Thawing takes only a few seconds. A survival rate of 80 per cent has been achieved—some 30 per cent higher than with embryo freezing. After fertilisation, up to three embryos are inserted into the womb to improve the chances of one surviving. Chen expects a final rate of successful pregnancies of about 20 per cent, more than 5 per cent above the rate achieved by freezing embryos.

Similar work is also under way at other hospitals in Melbourne, Sydney and Adelaide's Queen Elizabeth Hospital. But Flinders is well ahead.

The work at Flinders is likely to be well received in Australia, where an often acrimonious debate has been waged between scientists, politicians, religious groups, and women's organisations over the ethical implications of *in-vitro* fertilisation. Later this year, the Australian parliament will be asked to vote on a private member's bill that would ban all research on embryos in Australia. The bill could stifle research on *in-vitro* fertilisation in a country, which has established a world lead in the field. □



Chen and his egg freezer. Top: the egg

. . . but iced embryos make money in the US

MOVES by Australia's leading freezers of embryos to market their methods in the US are being greeted with strident criticism at home, but with great enthusiasm in the US, where the home-grown technology is not nearly so advanced.

A company called IVF Australia has been formed to export the techniques of embryo freezing and hormonal stimulation of ovulation, pioneered by Alan Trounson and Carl Wood from Monash University in Melbourne. The first patients are being seen at the United Hospital in Port Chester, New York. A second clinic is planned for Birmingham, Alabama, and others will open later in the year. The United Hospital will treat up to 500 infertile couples a year.

The researchers from Melbourne will help train American doctors to use their techniques which have so far led to more than 250 births in Australia. IVF Australia will help married couples give birth only to their own children. Surrogate motherhood, will not be offered. Some 30 per cent of the royalties earned in the US will be ploughed back into research on *in-vitro* fertilisation (IVF). The rest of the royalties will go to Monash University to be distributed as the vice chancellor sees fit. Trounson denies that the researchers at Monash will get rich from the arrangement.

"We may make a few thousand a year as inventors but that will be split between the group, and it is a large group," he said. "We're all offered considerably more money to go into private medicine in Australia and the US."

The scientists have been accused of commercialising their work and being reluctant to talk about it publicly.

"Once commercial interests get involved, there will be a great deal of pressure on the medical profession to remain secret," says Robyn Rowlands, a former member of the Monash IVF team.

Monash has been criticised for not releasing details of how IVF Australia will be structured and financed. But Trounson denies any secrecy. "We will continue to work with other IVF groups from throughout the world," he says.

Meanwhile, in California, doctors at two hospitals have simultaneously announced the first of three pregnancies in the US resulting from frozen embryos. The babies are due between June and November. The announcement indicates just how far the US is behind in IVF work. Trounson's team announced the frozen storage of human embryos in May 1983 and the first baby was born using the technique on March 28 last year. □

Silt and earthquakes threaten new dam

CONSTRUCTION of the second highest dam in Asia may soon stop. The Indian Supreme Court will sit this week to hear a case brought by environmentalists in an attempt to halt further work on the giant Tehri Dam in the state of Uttar Pradesh. Opposition to the dam is backed by seismologists and soil scientists. The case has become a cause célèbre, reflecting growing concern in India and around the world about environmental degradation in the Himalayas.

The action is against the government of India and the state government of Uttar Pradesh, which plan to spend \$1200 million between them on the dam. In a petition to the Supreme Court, the Anti-Tehri Dam Committee challenges the dam "on geological, seismological, technical, environmental, social, economic and humanitarian grounds".

The dam is being built near the confluence of the Bhagirathi and Bhilangana rivers in the Himalayas, to a height of 260 metres. It will flood some 45 kilometres of the Bhagirathi valley and 25 kilometres of the Bhilangana valley. It will submerge the town of Tehri (the former capital of the princely state of Tehri-Garhwal) and 23 villages, displacing 70,000 people. Another 72 villages will be partially submerged, and others will lose their best agricultural land.

One thousand hectares of forest have been cleared in the Doon Valley and near Pathri to provide land for resettlement. But may farmers will be forced to cultivate the steep, higher slopes above the reservoir, where they will worsen already severe soil erosion.

A government commission, set up in

1980, has still not reported on the environmental effects of the dam, even though construction has begun.

Fears that the dam will quickly silt up have been reinforced by a report to the commission from the Wadia Institute of Himalayan Geology. The report warns that a combination of unstable local geology causing landslides, the heavy load of silt in the impounded rivers, soil erosion, overgrazing and deforestation "will inevitably

predicts that the dam will last no longer than 25-30 years, rather than the 100 years claimed by the government of Uttar Pradesh. The reservoir will simply silt up and become useless.

The geological instability of the area is acknowledged by the dam's promoters. "Essentially all rocks exposed are soft and erodible," says an early feasibility study prepared for the dam. "A major tear fault has caused widespread shearing of the bed

rocks." There have been landslides along the Bhagirathi and Bhilangana rivers near the fault, it says. "The slides are expected to be aggravated during conditions of rapid drawdown [of water in the reservoir] when a few more slides are expected to develop."

The study says that the area is seismically very active. The government's commission wants deep boreholes to be sunk to measure the stress in the local rocks.

Such tests have not been carried out. Until they are, the possibility of a major earthquake in the area and the catastrophic failure of the dam, with thousands of deaths, cannot be ruled out.

The Anti-Tehri Dam Committee is concerned that the dam's reservoir could itself induce an earthquake. Such reservoir-induced earthquakes have occurred in the past at Hsinfengkiang in China, Koyana in India and Lake Mead in California. A failure of the Tehri dam would engulf towns downstream, including Mumikireti, Rishikesh and Haridwar.

If the Supreme Court rules in favour of the Anti-Tehri Dam Committee, the decision could end plans to build four other high dams planned for other parts of the Himalayas. □



lead to sedimentation at an accelerated rate".

The report was completed more than two years ago, but remains formally unpublished. A copy was leaked to the Anti-Tehri Dam Committee, however, and the committee has submitted it in evidence to the Supreme Court.

S. P. Nautiyal, the retired Director-General of the Geological Survey of India,

Spoiling the view from the Channel Tunnel

A LIST of 65 possible sites for dumping spoil excavated from the Channel Tunnel has been drawn up, David Mitchell, a junior minister of transport, disclosed last week. Digging the tunnel will produce 4 million cubic metres of spoil in Britain, and a similar volume in France. Its disposal is becoming an important source of concern.

Mitchell was speaking on the publication of the Channel Tunnel Bill. This legislation gives planning permission to the tunnel, and a wide range of associated works—among them rail terminals at Cheriton near Folkestone, and Waterloo in London; improvements to the railway line between the tunnel and London; and a dual carriageway road between Ashford and Folkestone. Also included is the dumping of spoil.

About three-quarters of the British spoil will be used for building the main terminal at Cheriton and for land reclamation at the foot of Shakespeare Cliff, where the tunnel workings will be, to provide a construction

platform.

The Channel Tunnel Group originally proposed disposing of the remaining million cubic metres by extending the area of land reclamation at the foot of Shakespeare Cliff. However, the government wants other options investigated.

One possibility, Mitchell said, is to dump the spoil at Ramsgate. The council there wants to extend the harbour and could use spoil in the new harbour wall. But nobody knows yet whether the spoil is saline. If it is saline then this would rule out a number of inland sites for disposal.

The Channel Tunnel Group says it will not remove the spoil from the tunnel entrance by lorry because it would cause too much disturbance. So sites will have to be accessible by rail or barge. A possible site at Dungeness has been ruled out because of the ecological disturbance that dumping would cause. In France, the spoil will be dumped in a hole near the tunnel or taken away by road.

The extent of the Channel Tunnel Bill

removes any possibility of a public inquiry into any aspect of building the tunnel. Residents in Dover are planning to take their demand for a public inquiry to the European Court of Human Rights. However, a public inquiry will be held in France. The inquiry, which must last at least a month, will be held by the local council.

In Britain, scrutiny of the legislation will be confined to parliament. The bill is termed "hybrid", because it contains both public and private legislation. After the bill has been given a second reading, a select committee of the House of Commons will examine the "private" aspects of the bill.

Anyone who is affected by the tunnel will be able to object to the bill (at the cost of £2). The bill then goes from the Commons to the Lords where people will be able to object again while the bill is in committee (at the cost of a further £2).

The bill is expected to become law around spring next year. In France the treaty between the two countries simply has to be ratified by the national assembly. □

Global warming is linked to Sahel drought

THE WORLD is warming up as fast in the southern hemisphere as in the northern hemisphere, according to new data on world temperatures collected by British scientists. The warming was last week linked to retreating glaciers and African drought. It may be a consequence of the "greenhouse effect" due to increased amounts of carbon dioxide in the atmosphere.

Temperature measurements from around the world are collected and collated by a team at the Climatic Research Unit of the University of East Anglia, as part of a project funded by the US Department of Energy. Phil Jones, Tom Wigley and Mick Kelly have also been gathering and interpreting the best available historical records of temperatures both north and south of the equator. They believe that their latest figures, which suggest that the warming has been going on for most of this century, are the best yet—especially for the southern hemisphere.

Kelly says that the apparently large variability from year to year in the graphs for the early years reflects poor coverage at that time. He says he is confident of the reliability of the long-term trends. The graphs show both hemispheres warming by about 0.5°C in two stages; from 1920 to 1940, and in the past few years. Kelly says: "The fact that the temperature estimates for both hemispheres show similar long-term trends is strong confirmation of the reality of the warming."

Embryo centre fails licensing test

THE BODY of people set up a year ago to oversee work on human embryos has visited 25 centres in Britain during its first year. The Voluntary Licensing Authority believes that all but one of these centres follow its guidelines for such research, according to its first annual report*, published this week. The authority says the centre it has not yet approved, the Infertility Advisory Centre in Harley Street, must provide further information about its work on human embryos.

The authority, which has lay members as well as representatives from the Medical Research Council and the Royal College of Obstetricians and Gynaecologists, asks four questions before approving any centre's work on embryos. It asks whether the centre intends to modify the genetic make-up of the embryos, whether it intends to place the embryo in the uterus of another species, whether the centre intends to clone the embryo and whether it intends to grow the embryo beyond 14 days. "In every case the answer was no," the report says.

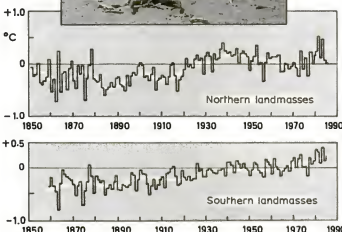
The authority says that "several centres" can freeze embryos, which may provide some clinical advantages but nevertheless "gives rise to important ethical dilemmas which have to be resolved".

The authority says that it agrees "in



Peter Ward/Corbis Collection

John Gribbin



North and south of the equator, it is the same, And Africa takes the brunt of the problems as the world warms

The early 1980s were the warmest years in both hemispheres. A cooling in 1984 and 1985 in the northern hemisphere fits in with computer predictions of the effect of the eruption of the volcano El Chichón in Mexico in 1982. Volcanoes send huge amounts of dust into the upper atmosphere

and so reduce the heat reaching the Earth's surface. This does not prove that the computer models are right, but it is encouraging for the modellers.

Independent confirmation of the warming trend comes from a new analysis of the retreat of mountain glaciers over the past 150 years. Climatologists have been puzzled that glaciers around the world should have shown such a marked retreat. However, J. Oerlemans, of the University of Utrecht, has been investigating the behaviour of glacier tongues in mountain valleys, and finds that they are particularly sensitive to the carbon dioxide greenhouse effect.

Oerlemans shows in last week's *Nature* that even a small "surplus" of infrared radiation in a valley partially filled by glacier ice can have a profound effect on the glacier. This is because the increased temperature of the unglaciated part of the valley causes a strong transfer of energy horizontally, which encourages the ice to retreat.

This effect disappears when the valley is completely glaciated, but it could explain why glaciers might be very good indicators of climatic changes induced by small shifts in the radiation balance

of the Earth. These are exactly the kinds of shifts that result from the trapping of infrared radiation in the Earth's atmosphere because of the build-up of carbon dioxide and other trace gases, derived from human activity.

Recent concern that the continuing droughts in the Sahel region of Africa may represent a long-term climatic shift also receives support from the same issue of *Nature*. This evidence again seems to tie in with global warming.

Scientists from Britain's Meteorological Office have compared recent changes in ocean temperatures with the occurrence of wet and dry years in the Sahel, the part of West Africa on the edge of the Sahara. They find that there is a clear link between drought years in this part of Africa and relative warmth in the oceans of the southern hemisphere and in the North Indian Ocean, taken together. (The North Indian Ocean seems, on this evidence, to act as part of the southern hemisphere.)

Sahel droughts happen in years when these oceans are warmer than the northern oceans. The link may be changes in the flow of westerly winds in the upper troposphere which are similar to changes in atmospheric circulation associated with the El Niño phenomenon.

This discovery places a premium on investigations into changes in ocean temperatures. The work at the Climatic Research Unit has so far concentrated on data from land masses around the globe. But Kelly says that the present aim of the team is to incorporate measurements of temperatures taken at sea by ships into the expanding archive of data on temperatures.

* The First Report of the Voluntary Licensing Authority for Human In Vitro Fertilisation and Embryology, 1986, Medical Research Council.

"I'd like to know where the Japanese are putting their money."

Wales has one of the largest concentrations of Japanese manufacturing investment in Europe.

The Japanese are highly impressed by the hard-working people and the pride taken in 'doing a good job'. They also like the close links between the universities and local industries and the well-developed communications network.

Perhaps the made-to-measure financial packages and the wide choice of greenfield sites have something to do with it, too.

And dare we say it? Wales has 117 golf courses, 3 National Parks and 4 areas of 'Outstanding Natural Beauty' - that's a total of some 1¼ million beautiful acres - all important to the Japanese who like to play hard as well as work hard.

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Experiments on animals: a balance of interests

One hundred and ten years after its last attempt, parliament enacts new legislation to control research on animals. But the teeth of the law still lie in its administration

Gail Vines

A YOUNG but despairing campaigner for animal rights walked into a park in Colchester last month, doused himself with petrol and set himself alight. This week parliament put the finishing touches on a new bill to control experiments on animals, replacing legislation enacted more than a century ago. "Too little, too late" is the verdict of some.

Anti-vivisectionists of a radical group known as Mobilisation for Laboratory Animals see the bill as "governmental whitewash", an "exercise in public relations that sells out animals". But scientists and moderate campaigners for animal welfare are optimistic on the whole that the bill strikes a "balance" between the interests of animals and research. The proof lies in the administration of the legislation.

A key change introduced by the bill—to be known as the Animals (Scientific Procedures) Act—is a dual system of licensing animal experimenters. Researchers will first need a personal licence, which is meant to establish their competence to work with animals. This licence will be similar to the licences now issued under the 1876 Cruelty to Animals Act. But the new act will require researchers to apply for a project licence as well. This licence will authorise them to carry out a particular programme of experimental procedures for up to five years (when the researchers will have to renew the licence). Both application forms and the project licences themselves will be lengthy and specific, giving details of procedures, the numbers of animals and the degree of suffering they are likely to experience.

The Home Office Inspectorate—the existing team of inspectors—will scrutinise applications. It has the power to set limits on the number of animals, to suggest alternative techniques and specify methods of relieving pain. It can also refer applications to outside assessors or to its own Animal Procedures Committee for advice.

The Home Office will thus have more control over what kinds of experiments it licences. A crucial question are the criteria upon which it will license projects. The bill introduces two new concepts to this decision-making process: a notion of degrees of suffering, and an assessment of the value of the research.

The concept of pain itself is widened to include distress and discomfort, and its severity graded into three categories—mild, moderate and substantial. Projects deemed to cause substantial pain will in theory need to be more stringently justified at the licensing stage.

The justification of a project is to be based on "scientific merit" and "potential benefit". The new act requires, somewhat ambiguously: "In determining whether and on what terms to grant a project licence the Secretary of State shall weigh the likely adverse effects on the animals concerned against the benefit likely to accrue as a



result of the programme to be specified in the licence." The notion is now that research that causes substantial suffering to animals will be approved only if researchers can convince the Secretary of State that it has great potential benefit, presumably in terms of human welfare.

The machinery is in place for the Home Office to exert greater control over experiments on animals. Under the act of 1876 the only limitation, applied to all research, was that it must not breach the "pain clause": a stipulation that an animal must be killed if it is judged to be suffering severe pain which is likely to endure. The so-called "termination condition" of the new act is stronger: it stipulates that an animal found in extreme pain must immediately be killed humanely.

A sticking point for such legislation is inevitably the definition of such key concepts as severe pain. The Home Office has issued guidelines with the bill. It plans to publish a code of practice that will list ways of deciding whether suffering in a particular species is "substantial". The new bill has flexibility built into it, in that definitions are detailed mostly in ancillary documents that the Home Office can alter without recourse to parliament. Such flexibility is meant to enable the legislation to keep up with the growing knowledge of animal welfare. But this state of affairs also means that the Secretary of State has considerable powers to alter practice in either direction. The Home Secretary will, however, be accountable to parliament for his administration of the legislation.

Premises that carry out research on animals have always had to be registered. Now institutions that breed or supply laboratory animals will also have to be registered and open to inspection. Three named people in each premise—the head

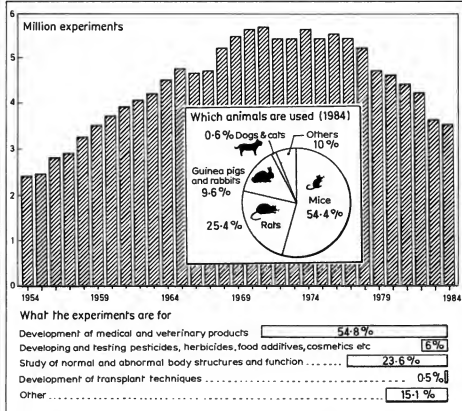
of a laboratory, a chief technician and a veterinary surgeon—will be responsible for the care of the animals. All animals used in research will now have to come from a registered breeding establishment, a stipulation intended to prevent pet dogs and cats from ending up in laboratories.

The new act will cover embryonic and larval forms of vertebrates, and the Secretary of State can extend cover to certain invertebrates, such as octopuses, should scientific evidence justify the move. The act further broadens the definition of "experiment" to "procedure", to take in techniques not now covered by the 1876

A wind of change for

LAST December the Swiss voted against a total ban on vivisection, by a majority of 70 per cent. Its pharmaceutical and chemical industries breathed a sigh of relief, but Switzerland, along with Britain, already has one of the most stringent sets of vivisection laws in the world. Most European countries lag behind both Switzerland and Britain, but greater homogeneity may be on the way. The Council of Europe has opened for signing by its 21 member countries a convention intended to improve the lot of the laboratory animal. The convention urges governments to require prior notification of animal experiments, to issue rules that will avoid causing suffering of animals and reduce the number of unnecessary tests. The convention may be a first step in European countries such as Italy which has virtually no controls over scientific experiments on animals.

Pressures for tighter standards for laboratory animals are also growing in the US. Congress recently amended the Animal Welfare Act, to require "institutional



act, such as the production of antisera and the passage of tumours through animals. The destruction of brains (decerebration) will also become a licensable procedure, which will make "pithed" frogs in school science lessons a thing of the past. However, the act also enables researchers to practice techniques of microsurgery on anaesthetised animals.

Researchers will have to pay £60 for a personal licence, but the Treasury will reimburse workers in university and government laboratories. For the first time, researchers will have the right to appeal if they are refused a licence.

Laboratory animals worldwide

animal committees" in the 2000 institutes that carry out research on animals and are engaged in interstate commerce. The committees are charged with the task of regularly inspecting research facilities. The welfare of laboratory animals in the US is also improved by recent revisions to the Public Health Service guidelines for the care of animals. The guidelines have clout: the National Institutes of Health recently withheld research funds from two institutions because of signs of cruelty or neglect in their animal houses. The new regulations will also require funded institutes to establish "animal use committees" to review research proposals. A recent report from the Office of Technology Assessment, *Alternatives to Animal Use in Research, Testing and Education*, concludes that these developments will together "bring the overwhelming majority of experimental animal uses in the United States under the oversight of a structured local review committee."

A statutory committee, the Animal Procedures Committee, replaces the advisory committee and may have more power in practice. The committee can advise the Home Office on ways of preventing suffering and of reducing the number of toxicology tests (such as the Draize test in which chemicals are tested on rabbits' eyes). The committee is empowered to set up subcommittees to carry out specific investigations, and it must make an annual report. The composition of the committee, although contentious, is roughly outlined. Of 13 members, eight must have scientific, medical or veterinary training, while one of the remaining members must be a lawyer.

Two controversial clauses remain. One addresses the practice of "reusing" animals. The government, under pressure from animal-welfare groups, initially intended to prohibit further experiments on any animal that had undergone anaesthesia and allowed to recover. The loose definition of an experiment as "a set of procedures" casts doubt on the precise meaning of "reuse", in any case. But researchers argued that "reuse" as defined as one further experiment under terminal anaesthesia (with the animal never recovering consciousness) should not add to its suffering and would prevent further animals from dying needlessly. This view has now won through, in an amendment.

Some debate also centred on the clause that makes it an offence to breach confidentiality: for disclosing, that is, "any information which has been obtained by him in the exercise of those functions (under the act) and which he knows or has reasonable ground for believing to have been in confidence". Intended to protect commercial secrets and the like revealed in applications for project licences, critics have argued that the confidentiality clause

is so severe that it will prevent researchers from adequately informing the public or even the Home Office of potential abuses.

The new legislation has made its way through parliament with remarkably little opposition. The government attributes its easy ride to "extensive consultation" with scientists, industrialists and animal welfare groups, notably the British Veterinary Association (BVA), The Fund for the Replacement of Animals in Medical Experiments (FRAME), The Committee for the Reform of Animal Experimentation (CRAE) and the Royal Society for the Prevention of Cruelty to Animals (RSPCA). Industrial interests, the Animals in Medical Research Information Centre, for instance, welcome the bill on behalf of the pharmaceutical industry.

The Research Defence Society, supporting the interests of the 20 000 licensees, is also pleased with the new act. James Noble, its executive director, complains only that the bill will add to the administrative burden of hard-pressed scientists: "Researchers will have to do a lot of work just to stand still," he says. "The act will cost time and money at a time when the scientific establishment is already under attack through lack of funds." He suspects that administrative red-tape will cause problems and advocates more inspectors. The Home Office has agreed to increase by six its 12 field inspectors, but Noble argues that its numbers should be doubled.

The moderate advocates of animal welfare see the bill as a step forward. "Before, anyone could do almost anything they wanted once they got a licence," says Bill Annett, secretary to the trustees of FRAME. David Morton, of the BVA, is "pleased to see the veterinary profession being increasingly involved". We have something to offer to ensure the health and welfare of laboratory animals. Less-stressed animals will also lead to better science.

Both the BVA and the RSPCA, however, would like to see greater controls over euthanasia, to ensure that competent people do it. They would also like to instigate compulsory training for licensees in surgical techniques and the like. But the framework of the new bill is sound, most feel. "All the machinery is there to really tighten things up and improve the situation, including reducing the number of animals and promoting alternatives. It all depends on how well the project licensing works. We'll know in three years time," says Judith Hampson of the RSPCA.

The Mobilisation for Laboratory Animals, which sought to ban experiments on animals for research into alcohol and tobacco, weapons testing, cosmetics, psychological research and the toxicity tests of LD₅₀ and Draize, achieved none of its objectives. Richard Ryder, a long-time campaigner for animal rights, also condemns the new bill: "It produces new red tape but does not advance the animal's position. It is a slap in the face for the animal welfareists who have campaigned for 15 years through democratic channels." But Judith Hampson is more hopeful. "I see it as a beginning, not an end. Advances will depend on the vigilance of the animal welfare movement in continuing to bring pressure to bear on the government and parliament."

SCIENCE

Interferon makes cancer drugs more effective

LUNG CANCER is almost always a self-inflicted disease. It kills 40 000 people each year in Britain. In Scotland, where the death rate is the highest in the world, one person dies of the disease every two hours. But until doctors find a way to stop people smoking altogether, medical researchers will continue to concentrate a large proportion of their efforts and resources into the search for a more effective treatment.

At a press conference last week, researchers from the Imperial Cancer Research Fund (ICRF) announced an exciting new lead in their work on lung cancer. Professor John Smyth and his team at the Medical Oncology Unit in Edinburgh have had promising results with a new form of treatment, which combines alpha interferon with a drug used in chemotherapy.

Treatment of lung cancer is complicated by the fact that "lung cancer" is several different diseases. Small-cell lung cancer accounts for a quarter of all cases; it is extremely malignant and, until recently, patients were not expected to survive more than 8 to 12 weeks. With new types of chemotherapy the outlook is better;

survival averages one to two years. After that time, however, the drugs seem to lose their effectiveness. The other 75 per cent of lung cancers consist of a variety of "non-small cell cancers". They do not respond so well to treatment with cytotoxic drugs and usually require surgery.

One of the biggest successes at the Edinburgh unit has been the development of new techniques to grow tissue from human lung cancers in the laboratory. This is an important advance. For many years, researchers have had to try out their treatments on animals and hope that what worked for animals would also work for people. That, unfortunately, is not always so. With cultured human lung cancers, Smyth and his colleagues have the opportunity to look more closely at the biochemical mechanisms underlying human cancer. One question they hope to answer is why it is sensitive to treatment in the short term but seems to become resistant after a year or so.

Smyth and his team have tried various forms of therapy on their cultured cancers. They found that the combination of small amounts of interferon and chemotherapy is

so effective that they are now planning a small clinical trial in Edinburgh. Interferon, which has been successful in treating people only with a rare form of leukaemia (*New Scientist*, 6 March, p 20) does not have any effect on lung cancer by itself. Smyth found in laboratory tests that if interferon is given with a cytotoxic drug, such as cisplatin, together they caused the tumour to shrink up to six times as much as the drug alone. "The interferon acts as a 'potentiator'," says Smyth. "It makes the drug very much more effective." However, he added, "until we try, we can have no idea whether the treatment will work. But the lab results are so promising that the therapy must certainly be tried in patients." If the treatment is successful in the trial, then the ICRF will extend the trial to patients throughout Britain.

The combined interferon-drug treatment could have other advantages for patients. In small-cell cancers, where drugs are already effective in shrinking tumours, the addition of interferon might mean that doctors can reduce the dose of the drug—and so reduce the very unpleasant side effects that generally accompany chemotherapy. □

ICE finds more of a wave than a shock

WHEN the International Cometary Explorer (ICE) came within 7800 kilometres of the comet Giacobini-Zinner in September, the first impression was that there was no "bow shock" at the comet. Now, the evidence seems less clear; while there may not be the same well-defined region in space as there is around the Earth, there is definitely a "transition region"—perhaps more of a "bow wave" than a bow shock. This is one conclusion presented in a series of eight papers that have just appeared in *Science* (vol 232, p 353).

The bow shock is a region around a body in space—a planet, moon or comet—where the solar wind, the stream of ions and electrons from the Sun, meets the local magnetic field. Although there is no

evidence of a bow shock at Giacobini-Zinner (*New Scientist*, 28 November 1985, p 22), the ICE did pass through three distinct regions.

The instruments on the ICE measured the plasma electrons, magnetic fields, plasma waves, radio waves, plasma composition, low-energy cosmic rays and energetic protons. The exact nature of the region where the solar wind meets the comet's own plasma will become clear only when the scientists working on the different instruments begin to piece their results together, a process that is now under way.

At about 2-3 billion kilometres from Giacobini-Zinner, the spacecraft began to feel the presence of the comet. In this

region the magnetic field of the comet begins to pick up the ions in the solar wind. The ICE detected this as a turbulence in the electric field.

At about 500 000 kilometres from the comet, the ICE detected a second region, where the comet begins to influence strongly the path of the particles in the solar wind. This is where the spacecraft would have detected any bow shock. Most of the papers in *Science* report no evidence of a bow shock, but measurements of the energetic ions in this region, reported by R. J. Hynds at Imperial College, London, and a team of four other scientists (*Science*, vol 232, p 361), showed "a sharp transition, indicative of a shock," about 100 000 kilometres from the comet.

The third region around the comet begins about 10 000 kilometres away. Inside this region, the tail of the comet, the temperature of the plasma is much lower than it is in free space—13 000 K rather than 250 000 K. However, the density of the electrons is much higher—670 electrons per cubic centimetre rather than 10 in free space.

The ICE found that there is a very strong interaction between the comet and the solar wind. One of the more significant results of the ICE project, was the discovery of the effect of the comet on the interplanetary magnetic field. There is a lobe composed of magnetic field lines of one polarity on one side of the comet's plasma tail, with a lobe of the opposite polarity on the other side of the tail. Or, as the scientists describe it: "The outward motion of the solar wind carrying magnetic field lines causes the field lines to be bent round around the nucleus like spaghetti around a fork." □

Honey possums make the most of their meals

THE Australian honey possum (*Tarsipes rostratus*) is a mouse-sized marsupial that feeds exclusively on nectar and pollen. K. C. Richardson and R. D. Wooller of Murdoch University and B. G. Collins of the Western Australia Institute of Technology have found that the possum is well adapted to its diet (*Journal of Zoology*, vol 208, p 285).

The possum's long, thin tongue is strengthened with a stiff keel so it can poke into a flower's deepest recesses. At the tip of the tongue a brush of 600 or so papillae draws up nectar by capillary action. It gives up its load when pressed against the palate. When nectar is plentiful, the possum stores it in a side chamber of its stomach. Pollen grains are picked up by shorter papillae in



IAN HARRIS/GOSSAMER

the middle of the tongue and are scraped off by combs in the roof of the mouth.

Nectar is rich in sugars but pollen provides proteins, fats and vitamins. Pollen grains are protected by tough coats so how does

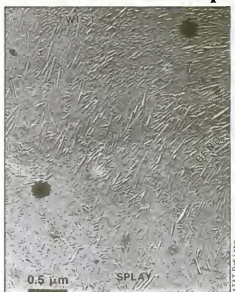
the possum extract their nutritious contents? To find out, the researchers sampled the contents of the possum's gut at various points along its length. They found that pollen in the stomach was intact, but further along, in the intestine, were many empty grains. The husks were undamaged: Richardson and colleagues suggest that digestive enzymes gain access to the nutritious parts of the grain through pores in the outer coat as the pollen passes along the intestine. □

Tobacco virus behaves like liquid crystals

LIQUID crystals are fascinating materials that have become familiar through their use in digital displays. The molecules in these liquids align themselves spontaneously, in a variety of ways, depending on the external conditions and the precise nature of the liquid. Observing this ordering directly is not possible because the molecules are so small, but physicists in the US have discovered how to study a very similar system microscopically. Surprisingly perhaps, the analogue comes not from physics but from biology, in the guise of the tobacco mosaic virus (TMV).

Scientists have known since the 1930s that a suspension of TMV in water can behave like the simplest of liquid crystals, the "nematics". In nematic liquid crystals the rod-like molecules align in one direction, rather like matches in a box, but show no further periodic behaviour. In water, TMV particles behave in the same way, provided the concentration lies within a fairly narrow range of values. The particles are like rods, each about 0.32 micrometres long and 0.02 micrometres in diameter, and they resemble the long molecules in nematic liquid crystals magnified about 100 times.

Now Robert Meyer at Brandeis Univer-



TMV models for liquid crystals

sity and Joseph Zasadzinski of the AT&T Bell Laboratories at Murray Hill, New Jersey, have found a technique for producing "freeze-fracture replicas" of these

TMV nematics, which allows them to study the system in an electron microscope (*Physical Review Letters*, vol 56, p 636). The researchers trap a thin layer of the liquid, only a few tens of micrometres thick, and freeze it rapidly, so that rather than crystallising, the water vitrifies. This process apparently preserves the distribution of the TMV particles without damaging them. The frozen samples are then fractured, and the exposed surface replicated for transmission electron microscopy.

The electron microscope images show how the TMV nematic displays the same kind of distortions that occur in nematic liquid crystals. Three characteristic distortions—called twist, splay and bend—are clearly visible. In the twist distortion, for example, the particles change orientation abruptly by 90°, along a narrow "disclination" line.

Meyer and Zasadzinski hope that they can learn more about the kinds of deformation that can occur in nematics by studying images like these in more detail. This will help in understanding the forces at work between the molecules in nematics, which until now have been observed only indirectly. □

When people stood on their own two feet

ERECT posture and bipedal walking came early in human evolution, probably between five and four million years ago and not long after the ape and human lines diverged. Becoming upright was probably the most important milestone in human evolution. It involved major changes to the skeletal and muscular systems. But did the basic circuitry of the

central nervous system (CNS) also have to be reorganised to meet the biomechanical demands of the new stance?

Four researchers at the Good Samaritan Hospital's Neurological Sciences Institute in Portland, Oregon, believe that the necessary neural circuitry was already present in our four-legged ape-like ancestors and goes back still further (*American Journal of*

Physical Anthropology, vol 69, p 93).

Donald Dunbar and his colleagues experimented with people and cats standing on all fours and upright on moving platforms. They found that when their balance is disturbed, both species automatically correct their stance in the same way when on four legs: they correct primarily with their hindlimbs and use their forelimbs mainly as supports. The hind limbs are also dominant during quadrupedal walking.

Although a cat balanced on its two back legs corrects its posture differently from a human subject standing upright, it has to do this, say the researchers, because of morphological constraints not because of any basic differences in CNS circuitry. Unlike humans, it cannot straighten its hips and knees so it has a crouching stance instead of the human's pillar-like posture.

A cat, of course, does not stand upright often. But in these experiments they were able to keep their balance. That means, says Dunbar, that they have the necessary neural control mechanisms to do so. The researchers conclude that cats and humans have the same basic neural circuitry for automatic adjustment of stance.

If a carnivore and a primate have similar mechanisms within the CNS for automatic control of posture and limb movements, then, suggest Dunbar and his colleagues, the pattern was present in ancestral mammals of at least 65 million years ago. It could be, they say, that control of posture by the hindlimbs is common to all four-limbed vertebrates (tetrapods).

If the quadrupedal, ape-like precursors of hominids corrected stance with their hindlimbs the transition to habitual bipedalism would have been easy. Thus, they conclude, there was no need for a reorganisation of the basic CNS circuitry to cope with upright stance. □

A duck's eye view of the world

BIRDS are renowned for their visual skills, but do any achieve completely panoramic vision? Although popular wisdom suggests that many do, none has ever been investigated in the laboratory. Now, Graham Martin of the University of Birmingham has found that at least one species, the mallard (*Anas platyrhynchos*), really does enjoy a panoramic view of its surroundings (*Vision Research*, in press).

Martin used an ophthalmoscope to measure the visual fields of his ducks. This device directs a beam of light into the subject's eye along the line of sight of the observer, who sees a reflection from the subject's retina. To survey an animal's visual field, the observer simply moves

around the immobilised creature and notes the point at which light is no longer reflected. That position marks the boundary of the retina—and so the field of view.

Martin's results reveal that the mallard's visual field completely encircles its head. Without moving, it can keep an eye not only on the entire horizon but also on the full celestial hemispheres. As the fields of view of the two eyes overlap, the duck also manages to view a narrow vertical strip of space through both eyes. This strip (the binocular field) is about 20 degrees wide and runs right the way over its head from front to tail.

The bird's bill lies just at the boundary of the binocular field, where vision may not be of the highest quality. In this respect, the duck differs sharply from the pigeon, whose bill falls well within its binocular field. The contrast probably reflects the pigeon's need to make accurately directed pecks at food and the mallard's less precise method of feeding on watery vegetation.

Martin argues that the mallard's feeding habits have freed it from constraints on the position of its eyes. That freedom has allowed it to create the panoramic visual field. As a result, the mallard, which effectively has eyes in the back of its head, can detect predators approaching from any quarter. □



A duckling can't escape its mother's watchful eye

Marriage, separation and the immune system

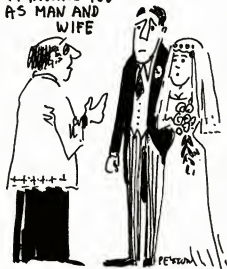
"THE simple presence of a partner is not equivalent to a supportive relationship." Not, that is, according to Janice Kiecolt-Glaser, a psychologist from Ohio State University. She was not just talking about the psychological effects of being in an unhappy marriage. It seems that having the wrong partner can also have a harmful effect on your immune system.

During the past five years, Kiecolt-Glaser and her husband Ronald Glaser, who is an immunologist, have been investigating aspects of psychoneuroimmunology, the way in which the "mind" (or brain) influences the body's immunity to disease. Kiecolt-Glaser announced their results at a recent meeting of the Society of Behavioral Medicine in San Francisco.

In one study they found that medical students who felt stressed by examinations showed a fall in the activity of natural killer (NK) cells, a group of white blood cells whose function is to destroy infectious organisms. Students who were lonely as well as stressed were even worse off and their NK activity was reduced further.

The body's immune system operates at two levels: one relies on cells such as the natural killer cells, the other depends on the production of antibody proteins. The Ohio team found that antibody production is also sensitive to stress. The *Herpes simplex* virus, which produces cold sores (usually on the lips), does not leave the body once the sores have cleared. It lies dormant in the nervous system. There is increasing evidence to suggest that when people are weakened, for example by stressful events in their lives, the virus migrates back along the facial nerves to produce more sores on the lips. The recurrence of herpes infection is followed by an increase in the antibodies

I IMMUNISE YOU
AS MAN AND
WIFE



that white blood cells produce against it. The Glasers found that the levels of these antibodies also rise with the stress of examinations and they are higher in lonelier students. It seems, therefore, not only that both mechanisms of immunity are sensitive to stress, but also that social support might act as a buffer, somehow conferring immune protection.

Researchers have known for years that the loss of support from friends or relatives increases an individual's susceptibility to illness. Recently bereaved men are more likely to die than married men of a similar age, and divorce leads to increased mortality from pneumonia and tuberculosis in both sexes. Kiecolt-Glaser and Glaser studied a group of women who had

been recently separated or divorced, in order to find out whether this increased mortality results simply from self-neglect following bereavement or if it is caused by some underlying immune defect. They found that the women's immune systems were depressed—the number of NK and other immunologically active cells were reduced, white cells that normally produce antibody showed a reduced response, and herpes virus activity was increased compared with a matched group of married women. The shorter the time of separation and the greater the woman's fondness for her (ex) husband, the greater the disturbance to her immune system.

But "adequate social support" does not mean simply having a man—any man—in your life. Living with the wrong partner produces its own immunological problems. In a group of 38 married women, those whose marriages were poor were more psychologically depressed. They had depressed levels of white cells and responded badly in laboratory assays designed to measure their immune responsiveness. In addition, herpes antibody was raised, suggesting increased viral activity.

This is the first time that anyone has examined the immune consequences of being separated from someone you care for, or of being forced to live with someone you don't. The results are not yet published, they need to be repeated, and further work must be done to show that such immune defects lead to physical disease. One thing is clear, though: in time, most people get over bereavement or divorce. But, if you are stuck with a partner you don't want, you are probably stuck with the problems of reduced immunity.

Clive Wood

Magnetic fields speed reaction rates

UNTIL recently the idea that magnetic fields applied externally could affect chemical reactions (except perhaps at very low temperatures) was anathema to chemists. The energies involved in magnetic effects, they said, are too small to be important. The degree to which any applied field can change the energy of reacting atoms and molecules is negligible compared with the size of most common activation energies. So how could magnetic fields possibly affect chemical processes?

This argument falls down because it restricts the idea of "chemical processes" to one of thermodynamics. Researchers could not study the effects of magnetic fields any further until they found out whether magnetic fields could affect the rates of chemical reactions. Rates of reaction do not depend entirely on energetic factors. They are also affected by the order or disorder of a reacting system—in other words, by its entropy. But is there any reason why a magnetic field should affect the entropy of a reacting system?

Scientists have known for a long time that single electrons behave like tiny magnets, and so they respond to magnetic fields. If reactions involving free radicals (atoms or groups of atoms with one unpaired electron) were exposed to magnetic fields then the way that their

unpaired electrons spin should be affected. This would affect the ordering, or the entropy, of the system and so, in turn, it should change the rate of reaction.

Ron Lawler of Brown University, Rhode Island, made this prediction in 1971. Chemists working in Novosibirsk in the Soviet Union reported observations that confirmed the idea soon after. Since then, there have been many reports of magnetic field effects in the literature.

Keith McLaughlin of the department of physical chemistry at Oxford University explains that a magnetic field can have an effect on reaction rates and efficiency at two levels (*Molecular Physics*, vol 55, p 557). In very high magnetic fields of about 10 000 gauss it is possible to change the amount of product formed in a reaction involving free radicals by 60 to 70 per cent.

McLaughlin, however, is more concerned about the effects that low magnetic fields can have on the free radical reactions going on in our bodies. Throughout the world, hospitals are gradually abandoning the use of X-rays in diagnosis. Imaging by magnetic resonance is taking their place. The patient in a magnetic resonance machine experiences short bursts of very high magnetic fields. Machine operators work in much lower strengths of field, but for longer periods. McLaughlin says

that both patients and operators could be at risk. "I am not insinuating," he says "that the magnetic field is genuinely dangerous to anything like the same extent that X-rays are dangerous, but there are effects that will occur because of this." Research into what these effects might be is still in its infancy. There are reports in the literature, however, which suggest that the rate at which DNA is repaired can be cut down by as much as 10 per cent in the presence of quite weak magnetic fields.

The effects of magnetic fields become more useful when they are deliberately applied to specific reactions. They affect rates, they can affect yields and it looks as if by working in the right conditions, chemists might even be able to use them to change the type of product that is formed. Nicholas Turro and Bernhard Kreuter, working at Columbia University, New York, have already demonstrated that magnetic field effects are enhanced when reactions are carried out in micellar solutions (soap solutions).

Chemists in industry should be interested by the finding that the efficiency of many free radical reactions can be affected by modest magnetic fields. With a large turnover, even small percentage increases in yields would have rather cheerful applications.

Judith Bunting

TECHNOLOGY

The Sun's threat to coal

Ian Anderson, San Francisco

reflects some of the light."

The main distinguishing feature of the cell, however is the way in which impurities are added to the silicon (doping). The

there is no electrical current.

The cell developed at Stanford concentrates the doping in a series of 17 000 pockets arranged in chequerboard fashion across the bottom of the back of the cell. The arrangement is called "point contact",

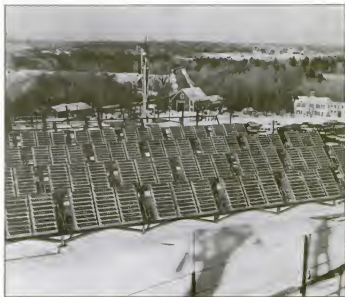
because the electrical current is collected in a series of tiny dots or points, instead of using the entire surface. "By shrinking the volume of the cell that has impurities, there is less likelihood of recombination," says Richard Swanson, the electrical engineer who has led the research project at Stanford.

The cell is built on a silicon chip which is 80 micrometres thick—much thinner than a conventional solar cell—and is three by five millimetres in size. The small size allows the sunlight to be concentrated by a Fresnel lens—the type often seen on the flat rear window of vans to allow drivers to obtain a broader view.

Silicon is competing with gallium arsenide for use in solar cells, and researchers have achieved efficiencies of 26 per cent with gallium-arsenide cells. But gallium arsenide is more expensive than silicon and will

require new kinds of machines to manufacture the cells. The silicon cell can be made by using standard integrated circuit technology.

Swanson claims that the new cell could produce power at a cost of \$2 to \$3 per watt, about half the cost of today's solar technology. One day 34 per cent efficiency might be achieved, he says, but 29 per cent is the current "practical limit". □



Solar power could be California's alternative to fossil-fuel power stations

impurities—phosphorus, a negative impurity, and boron, a positive impurity—increase the number of charge carriers (electrons and holes) in the semiconductor and thus the electrical current generated. In conventional cells, the impurities permeate the silicon, but this adds to the chance of the impurities acting as a catalyst for the recombination of the electrons and the holes. If the electrons and holes recombine,

THE LARGE-scale generation of electricity from solar cells moved a step closer last week. Engineers at Stanford University in California announced that they had developed a new type of photovoltaic cell.

The cell, which is based on silicon, has converted 27.5 per cent of the solar energy it received into electricity—only about 4 per cent less than the efficiency of a coal-fired power station. Currently, the best solar cells run at only 21 per cent.

The engineers from Stanford say they will soon reach 29 per cent efficiency—a rate that sceptics told them was impossible. Edgar A. DeMeo, manager of the solar programme at the Electric Power Research Institute (EPRI), said: "We regard the work as a breakthrough. Next we must find out if we are dealing with a laboratory curiosity or something that can be manufactured in an industrial setting at an affordable cost."

The EPRI, based in Palo Alto, California, receives millions of dollars each year from electric power companies in the US to invest in promising technologies. The institute and the Sandia National Laboratories in Albuquerque, New Mexico, funded the research at Stanford. The EPRI has joined forces with Acrican, a solar technology company based in San Jose, California, to determine if the new cell can be developed commercially. The EPRI will put \$10 million into the study.

DeMeo says that the cell's first application may be in space, to power satellites. But if an efficiency of 25 per cent or higher is achieved, the cells could be part of solar arrays that would compete with conventional sources of power such as oil, natural gas and coal in areas where sunlight is abundant.

The engineers from Stanford achieved the high efficiencies by modifying the design of solar cells. A solar cell generates electricity when particles of light, or photons, hit the cell, which is made of a semiconductor material. The photons excite negatively charged electrons in the silicon, breaking the bonds holding the electrons together. The electrons leave behind tiny holes. These "electron holes" have a positive charge and are also free to move around. Electrons and holes are attracted to positive and negative contact points, and set up electrical currents.

The cell developed at Stanford has a roughened surface to trap light, which bounces about within the silicon, dislodging electrons and creating "holes". "The light ray has several chances of being absorbed, rather than one or two with a normal solar cell," DeMeo says. "Also, the new cell gets rid of the metal grid off the front, and that's important because the grid

NASA is planning to build a jet-powered plane that has rear wings joined to front wings. The rear wings look as if they have been put on backwards. They sweep forward from the tail and join the front wings near their tips. The arrangement forms a diamond-like pattern.

NASA's officials are convinced that the design will result in stronger planes that are up to 30 per cent lighter than conventional planes of the same size.

The rear wings act as a truss or brace for the conventional-looking front wings. The overall weight of the plane can be reduced, thereby increasing fuel efficiency and the weight of payloads. The design has aerodynamic benefits too. It gives better lift because of the interaction between the two sets of wings, and there is less drag. The plane will be restricted to subsonic speeds. Intersecting shock waves would be generated if the plane reached supersonic speeds.

Last week, NASA entered an agreement with ACA Industries of Palos Verdes, California, to build an "advanced concept" joined-wing aircraft. A model will be tested

in a wind tunnel in September. The company expects to have the plane ready in 13 months. Flight tests will begin in early 1988 at the Ames-Dryden Flight Research Facility in the Mojave Desert.

ACA holds two patents on the design it will use. Julian Wolkovitch, the company's founder, developed the design 10 years ago in an attempt to build a safer hang-glider. That project foundered because of lack of funds, but Wolkovitch later received financial support from the US Navy to apply the design to aircraft.

To build a test version of the new plane, ACA will modify an existing jet-powered plane which has a scissor-like oblique wing. The wing will be removed and ACA will use the fuselage, which is 11 metres long, to mount the joined wings. The oblique wing is another odd-looking design that has a promising future for Navy airplanes. It can be moved diagonally across the fuselage for supersonic flight and at right angles across aircraft for subsonic flight. Rockwell has a contract to build a new oblique-wing aircraft. □

Diamond design for jet wings

Pulsed lasers clear 'portwine' birthmarks

Jeff Hecht, Boston

AMERICAN RESEARCHERS are testing pulsed, organic-dye lasers in an attempt to treat people with portwine-stain birthmarks.

Portwine stains tend to appear on the head, neck and torso. For years, dermatologists could only recommend make-up or harsh surgical treatment, such as skin grafts or freezing the affected skin.

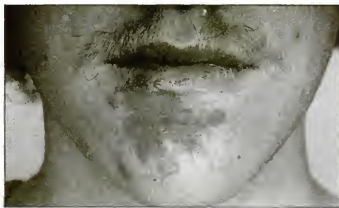
In the 1960s, argon lasers proved an effective way of removing some portwine stains. The idea was to use the laser's energy to close the abnormal blood vessels under the skin's surface that give the characteristic deep red colour of portwine stains.

Unfortunately, the blue-green beam of an argon laser is not absorbed strongly in blood, so much laser energy goes into the surrounding tissue and can cause third-degree burns. The treatment is also painful and requires at least a local anaesthetic.

The organic-dye laser, which American researchers are testing, operates at wavelengths that can be tuned to haemoglobin's peak absorption at 577 nanometres in the yellow part of the spectrum. Researchers hope to lessen side effects and to treat patients who cannot be helped with an argon laser.

Oon Tian Tan, now at the Boston University Medical Center, has treated about 30 patients with a pulsed, organic-dye laser. Pulses from her dye laser, made by the Candela Corporation in Natick, Massachusetts, last 300 microseconds. Tan treats patients in several, 20-minute

sessions to bleach the birthmark gradually. She says patients feel a pricking sensation when a laser pulse hits their skin, and only mild heating rather than the burning



Pulsed lasers could help to remove such deep red birthmarks

caused by the argon laser. In a paper written with colleagues, Tan reports no scarring. She adds that "Postoperative wound care is unnecessary, and no infections have occurred."

At the Harvard Medical School and Beth Israel Hospital in Boston, Joel Noe and Kenneth Arnt plan to test a dye laser which, like the argon laser, emits a steady beam of light. They recently received a two-year grant from Coherent Medical, a laser manufacturer in Palo Alto, California, to treat 100 patients with portwine stains over five years.

Both groups are also studying dye lasers to treat other skin lesions, including some

caused by abnormal blood vessels. Although other vascular lesions are not as disfiguring as portwine stains, they are more common. Examples include prominent blood vessels in the nose.

● Researchers in the US are also working with lasers to find a way of preventing people from having a second stroke. Many strokes occur when weakened arterial walls burst, leaking blood into the brain. The patient may survive, but the weakened arteries remain, threatening further ruptures unless the artery is closed off. Neurosurgeons can block weakened arteries with clips, but this involves opening the skull and the surgery is risky. Also, some patients are too weak to undergo the operation.

At the Beth Israel Hospital in Boston, Gerald O'Reilly, a radiologist, is looking at an alternative—coagulating the weakened arteries with laser light transmitted by optical fibres passed through arteries. His aim is to treat patients too weak for the trauma of major surgery, as well as to reduce the risks for patients who could undergo conventional surgery.

Research is in the early stages. O'Reilly says that his group is "finding its feet", trying to identify the best laser wavelength and the proper dosage of laser light.

"A practical problem," says O'Reilly, "is the need for a new type of optical fibre." Current fibres, even those made from plastics, are so stiff that they would penetrate arterial walls. He needs soft fibres that are flexible enough to follow the contours of arteries without damaging their walls. □

Biotechnology helps chicken farmers

AN ISRAELI biotechnology company is marketing an immunological test that could make life easier for chicken farmers. The company says its technique could also make expensive, centralised laboratory testing, for such things as pregnancy, unnecessary.

Organics, a three-year-old company based in Rehovot, calls its product ImmunoComb. The first kit, put on the market in January, is a test for antibodies to two diseases found in poultry, Newcastle disease and infectious bronchitis.

Poultry farmers vaccinate against these viruses, but the vaccine often does not "take", or requires a booster. The only way to see whether the flock has been protected is to check for antibodies. For Newcastle disease, an expensive laboratory test based on the agglutination of red blood cells must be used. No similar test is available for bronchitis.

Organics' product consists of a plastic tray containing about 100 small wells and a flat plastic comb with 12 teeth. Each tooth carries a spot to which Newcastle antigens are bound, and another with bronchitis antigens. The plastic wells contain the solutions necessary for the farmer to carry out a test for antibodies to the diseases.

The farmer puts samples of the chickens'

blood into the first set of wells in the plastic tray. The comb's teeth are inserted into these wells.

Virus antibodies, if they are present in the blood, dissolve in the solution in the dish, then bind to the antigen spots. The comb is washed in the next set of wells, then in the next set it is exposed to anti-chicken antibodies. These bind to any virus-specific antibodies that have been picked up by either spot of antigen. The anti-chicken antibodies are linked to a peroxidase enzyme, which produces a blue colour in the third set of wells. The amount of blue reveals the amount of antibody to either virus in the original blood sample.

The comb also carries its own calibration curve, a row of spots carrying various known amounts of chicken immunoglobulin. The spots are just above the comb's teeth, so the globulins do not enter the assay wells, where they could interfere with the measurement. They are, however, exposed to the same enzyme-linked assay in the subsequent wells, which are deeper.

The advantage of ImmunoComb, says Jonathan Taylor from Organics, is its cheapness and simplicity. A kit for testing 30 chickens for the two diseases costs \$60, which is comparable to the cost of more time-consuming laboratory tests.

Organics is discussing with several companies the development of an ImmunoComb to test for allergies in people. Currently the most common test for various types of allergy antibodies, is an immunoassay sold by Pharmacia that costs \$6-\$8 per test. An ImmunoComb costing \$45, and carrying a range of tests for common types of antibody, could work out at a dollar a test.

Organics plans to develop tests for several human diseases. It would be possible to put chlamydia, gonorrhoea, syphilis, AIDS and others on one comb for venereal screening, says Taylor.

Organics already has a rubella test, which it wants to combine with pregnancy indicators such as HCG and alpha-fetoprotein to monitor pregnancies. Such ImmunoCombs could be available over the counter, says Taylor, as simple immunological pregnancy tests are now.

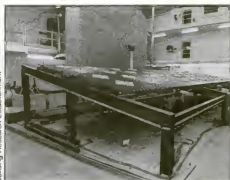
The test can be made quantitative, because the comb's teeth fit into the wells in standard microtitre dishes. The test spots can then be reacted with ordinary immunoassays in solution, and the colours read by standard colorimeters. ImmunoCombs could be used this way for monitoring blood levels in drugs, such as theophyllin, which must be tightly controlled in asthma patients. □

A testing time for steel roofs covered by snow

A COUPLE of vicious winters with unusually heavy snowfalls have caused some owners of buildings with light-gauge steel roofs to wish they had opted for a different design. About 20 of these roofs have collapsed under the weight of snow in recent winters, and the Building Research Establishment is trying to find out why.

Light-gauge steel is produced by cold-rolling (the usual method is hot-rolling, which gives a thicker component). Cold rolling is a more economical way of producing building components such as corrugated roof sections and purlins (the roof beams that run lengthwise). However, these lighter components have a nasty habit of twisting and buckling unevenly under loads and stresses, and designers still cannot be sure what the critical loads are.

The BRE's structural design division at the main testing laboratory in Garston, Watford, is putting three "roof" frames



Checking to see how snow affects roofs

with a variety of different cold-rolled steel purlins under different loading conditions.

The loads are applied via a series of cables running through holes in the floor of the testing laboratory. The cables are attached to the steel roofing with bolts and

pressure plates that spread the load. The cables are pulled tight to specific pressures (which imitate the loads snow can put on this type of roof) by a computer-controlled hydraulic system housed in the basement.

The scientists from the BRE picked loadings that show what happens when snow covers a roof evenly and when it piles up in a drift. The tests go through normal, working-load tests, design-load tests, long-term load tests and a test to failure. BRE's scientists can calculate how much a roof will twist or buckle under a triangularly distributed load, such as a drift of snow, by taking the figures from the same weight of material distributed evenly over the roof. They also say that the figures for loads placed vertically along the roof will show how much the roof will shift out of true once it is in use. To work out the roof's strength, the designer should use the figures from loads distributed horizontally along the roof. □

Japan's electronic copy of a Steinway grand piano

THE MOST important skill for a maker of musical instruments these days is the ability to write software. Or at least it is for Roland, a leading Japanese maker of electronic keyboards. Of the £6 million that the company spends annually on research and development, between 50 and 60 per cent already goes on developing programs, and the percentage is increasing.

The most impressive software that the company has developed, however, is not for sale. It was used to unravel the sounds made by a Steinway, and to encode them digitally. The harmonics from each sound made by the Steinway were analysed in terms of amplitude and attenuation. These sounds are now stored in Roland's latest product, the RD 1000, an electronic piano which when played turns out the sounds of a Steinway.

A piano is particularly difficult to analyse, according to Ikutaro Kakehashi, Roland's president, because, unlike other instruments, it lacks linearity. When played pianissimo, it has completely different characteristics than when played fortis-

simo. Analysis is further complicated by the need to repeat the same processing for each of the piano's 88 keys.

One way of reproducing music from a piano would be to store the individual sound made each time a key is played, then reproduce it as required. But that method is not commercially viable, says Kakehashi, because the cost in memory would be prohibitive.

Roland's programmers have devised a method to overcome this problem which they call the "structured adaptive system". The company is not prepared to go into too much detail about this system, for fear of giving too much away to rivals. The system's crucial feature, however, is that it stores sounds in memory as groups instead of as individuals. When a key is struck, the sound is restructured, according to the force applied, by adapting one of these groups.

The resultant instrument, which goes on sale in Britain this month (April), may not sound sufficiently like a Steinway to satisfy a concert pianist, but at about £1500—a

fraction of the cost of a Steinway concert grand—it is probably good enough to keep the home enthusiast happy. And, in addition to piano, the RD 1000 can imitate other instruments, such as vibraphone or harpsichord.

Not content with simulating the sound of the concert piano, Roland is working on software which will simulate the acoustics of famous concert halls, such as the Carnegie Hall in New York. □

Wax cylinders

JAPANESE engineers are trying to recover the sound recorded on wax-cylinder phonographs. However, it is not easy to recover sound from the fragile cylinders.

Japanese engineers confronted that problem after 65 old wax cylinder recordings were uncovered at Mickiewicz University in Poland. Bronisław Piłsudski, a Polish anthropologist, recorded speech and songs of the Ainu people of Sakhalin and Hokkaido on the cylinders between 1902 and 1905. Sakhalin Island was annexed to the Soviet Union after World War II, and the folklore of its Ainu people has been lost. Hokkaido is Japan's large northern island.

In mid-1983, engineers at Hokkaido University's Research Institute of Applied Electricity were asked to find a way to play the cylinders. They were wary of using an old Edison phonograph, even if a working one had been available, because the 20-gram stylus pressure could easily damage the fragile wax cylinders. So Toru Ifukube, Toshimitsu Asakura, and Toshio Kawashima built a low-pressure stylus that reproduced sounds from the 41 intact cylinders.

Other cylinders could not be played mechanically because they had been cracked or broken. The engineers devised a non-contact laser system to do the job. By detecting the angle at which the surface of the wax cylinder reflected the light, the engineers were able to reconstruct the sound. □

Degradable composite mends bones

BROKEN BONES could soon be anchored together with a new type of composite material that will slowly dissolve away as the bones knit together, and the stress on the fracture decreases. The new material, made in the materials department of Queen Mary College in London, is based on a naturally occurring polyester, which can be broken down by enzymes in the human body.

The polyester, polyhydroxybutyrate (made by ICI), is a natural byproduct of bacterial metabolism. It is mixed with hydroxyapatite, a calcium substance which occurs in teeth and bone. The exact nature of the mixture has not been revealed, as a patent on the material is still pending.

Ray Smith and Christina Doyle are carrying out tests on the material. So far they have only *in vitro* evidence that the composite degrades slowly. However, they

say that they should be able to control the bio-degradation rate and process the material into useful shapes.

The thinking behind the new composite stems from the fact that the steel supports which surgeons screw into broken bones to hold them in place actually discourages bone growth. The replacement of bone is stimulated by stress, and the steel plates and rods are so strong that they remove all the load from the bone, causing a loss of bone mass around the anchored site and slowing down the rate of repair. Also, patients must endure a second operation to remove the supports once the bone has mended.

In theory, the new composite would gradually degrade, losing its strength but allowing stress on the bone to slowly increase. And there would be nothing to remove surgically. □

Scientists groom Andean tubers for Ethiopia

AFTER DECADES of neglect, crops in the Third World are receiving the benefits of modern science. One project that has just reached a crucial stage could help to turn some almost unknown Andean root crops into a suitable crop for the tropical highlands of Ethiopia.

Alan Brunt and his colleagues at the Glasshouse Crops Research Institute near Littlehampton, England, have been tackling virus infections, one of the main constraints to production in the root crops oca, arracacha and ullucus. Disease-free varieties of these crops are now ready for trials in their native High Andes. Eventually they could be planted in Ethiopia and other tropical highlands. The tubers' advantage is that they can survive frost.

When the Spanish colonists went to South America, oca, arracacha and ullucus, along with the potato, were the Incas' everyday foods. For unknown reasons, the Spanish chose to take the potato to Europe. Some 130 countries now grow potatoes. The other tubers remained peasant crops, grown by poor farmers in Peru and other parts of the High Andes.

Scientists collected stocks of the tubers from Peru and Bolivia. "What we found was that they were riddled with viruses," Brunt says. The plants were stunted, with yellow and misshapen leaves, producing only a fraction of their potential yield. More important, the viruses were of unknown types, and a potential scourge of other crops.

Brunt has just spent the past three years, on a project which Britain's Overseas

Development Administration paid for, identifying the viruses and breeding plants free of them.



Forgotten tubers preparing for a comeback

Brunt tries to grow virus-free plants with a technique called meristem-tip culture. This means cutting off a new shoot just as it starts to develop, and growing it in a culture tube until it becomes a new plant. The idea is to catch the plant before it is infected. Between 10 and 70 per cent of plants grown in this way turn out to be free of viruses. Putting a chemical with known antiviral properties into the culture sometimes helps.

This work, Brunt believes, will help to bring the cultivation of Andean tubers into line with the agricultural practices of developed countries. "In the Western world, we maintain elite crops of disease-free varieties. We are trying to bring these techniques to the Third World."

Brunt is cautious about the improvements that the virus-free varieties will

bring. "We are hoping for yield increases in the order of 30 or 40 per cent." However, the virus-free plants, and their tubers, appear strikingly different to those of the original stock. Trials in the field will show how quickly they became susceptible to new infections.

Brunt says he has been lucky to make so much progress with Andean tubers: "The viruses were quite amenable." Among the plants that could benefit from Brunt's work are sweet potatoes and yams—staple foods for hundreds of millions of people. "Only a handful of people are working on sweet potatoes," Brunt says. "When you consider the thousands working on domestic potatoes, this is an incredibly small effort."

Such work is often a race against time. Traditional crops are vulnerable to changing tastes, especially when people can afford imported food. "Peasant foods"—with all their qualities—can disappear without trace. □

Criming fighting

BRITISH TELECOM hopes to curb crime by putting 1500 UHF radio beacons on top of lamp posts in London by the end of the year. The beacons are part of a system called pinpoint, which will let drivers of vehicles at risk of attack, such as small mail vans and security trucks, tell a control centre where they are at all times.

The radio beacons on lamp posts will continually transmit grid-reference signals, which give passing vehicles with receivers a fix on their location. The vehicles will then transmit another signal back to a base station, which logs and displays their exact position on a city map.

This procedure, claims British Telecom, will let security firms and postal networks keep a continuous check on their fleet so that they can alert the police if a vehicle deviates from its planned route.

Erecting the 1200 to 1400 beacons needed to serve London within the M25 ring will cost £1 million. British Telecom will also charge a subscription of around £100 a year per vehicle using the beacons. The transceiver in each vehicle will cost £1000, and each central control station, with a Digital PDP-11 minicomputer, will cost between £50 000 and £1 million, depending on the complexity and number of vehicles to be controlled.

Pinpoint is based on a system for car navigation which was launched in January by Plessey. As a result, British Telecom cannot claim a patent monopoly on the technology and so cannot prevent other firms from selling similar hardware for cars.

"Pirate" vehicles with hardware bought from other companies will not be able to take advantage of the beacons, because the signals are encrypted. Encryption also prevents potential robbers from commandeering a beacon and putting out false signals to fool the control centre. The beacons are battery-powered to safeguard the service against mains failure. □

SPOT's images are criticised

EXPERTS are criticising one of the services offered by Europe's new remote-sensing satellite—SPOT. The satellite was launched in February by an Ariane rocket. It can take pictures of greater detail than other civilian satellites, and record images of the same area with greater frequency than rival remote-sensing services. The ability to take frequent photographs of the same area means that the spacecraft could monitor the growth of crops.

It is this area of monitoring agriculture that Mike Barnsley, a lecturer from University College, London, criticises. He says that distortions are introduced into images because of the way that SPOT takes its repeat photographs of the same area.

SPOT is in an orbit that passes over each part of the Earth once every 18 days. The satellite, however, is designed so that it can record an image of a given area once every two-and-a-half days by viewing what is directly below and what is up to 25 kilometres on either side. Unfortunately, plants do not emit radiation (either visible or infrared) uniformly. A field of corn viewed from directly above looks different when it is seen obliquely. Distortion of the image increases, in general, as the angle of view

increases, but the degree of distortion depends on the form and structure of the plant.

Barnsley viewed a number of crops from different angles in an attempt to find out how much distortion there is for each type. Barnsley found that images of sugar beet and grass field distort much more as the angle of view increases than images of apple and plum orchards. The distortion is symmetrical about 0° in the visible part of the spectrum, but markedly asymmetrical when viewed with infrared cameras. There were too many factors influencing distortion to find a simple way of correcting errors for a types of vegetation.

Barnsley says that his criticisms are not meant to undermine the value of SPOT's service. "Our concern is that the importance placed on the frequency of the service could be misleading if these distortions are not corrected for."

Paul Archer, sales manager of Nigel Press Associates, one of the two British agencies responsible for marketing the images, says that scientists at the headquarters of SPOT Image in Toulouse are looking for ways of correcting the distortions. Archer says that the 14 000 images already transmitted by SPOT exceed expectations. □

Glasshouse Crops Research Institute

The future of the Patent Office

A WHITE PAPER on intellectual property and innovation that outlines the future of the Patent Office was published last Tuesday. Employees of the Patent Office and professional patent searchers are not happy with many of the proposal. Patent agents, on the other hand, are in favour of its provisions.

The White Paper confirms that the Department of Trade and Industry will have off the Patent Office from the Civil Service. But the Patent Office will still be moulded by the government, as the Secretary of State for Trade and Industry will appoint its board.

The Patent Office already has its own publicity section, and this will now sell inventors the results of a private search through the Patent Office's database of past inventions. Companies which earn a living from carrying out searches worry that the Patent Office will undercut their prices.

Patent agents are pleased with the paper because they welcome the proposal that more patent disputes should be settled by the Patent Office, instead of going to the High Court. The Patent Office believes this will give people who are not backed by large companies more chance to challenge patents. Robin Lawrence, president of the Chartered Institute of Patent Agents (CIPA), says: "This could knock a nought off the cost of patent litigation."

The CIPA also welcomes the plan outlined in the White Paper for automatic protection of some designs. The proposal is that the shape of objects, such as a machine part, would be protected by a patent for 10 years. Car companies could apply such a law to prevent the import of dangerously substandard spares from the Far East.



Wingless planes

AN AEROPLANE with wings on the inside may seem unlikely, but the US Patent office has granted a patent on such an idea to Robert Carr of Oklahoma.

An aircraft flies because forward thrust creates a difference in pressure above and below the contoured wings. Carr's airplane described in US patent 4 568 042, does not have wings sprouting from the sides of the fuselage. Instead the new plane has a tunnel through the

centre, which has a rectangular section. The ceiling of the tunnel has a flat profile, but the floor bulges upwards like a bumpy road. Air entering the front of the tunnel streams through with higher velocity at the floor than at the ceiling, so there is a higher pressure on the ceiling than on the floor. This creates an upwards lift equivalent to the wing lift in a conventional plane. Rudders inside the tunnel and at the rear steer the plane.

If the invention works as claimed, it could have important benefits for the US military, which is continually trying to build aircraft that are invisible to radar. The prime requirement for such a plane is a smooth profile with no sharp edges which reflect microwave radiation.

Taking the static out of audio and video cassettes

3M, the Minnesota Mining and Manufacturing Company, has won a US patent (4 570 197) on an extraordinarily broad claim to a new way of making audio and video tape cassettes immune from static electricity. The idea, coating with conductive chemical, is very simple. Unless 3M's rivals fight the patent, the company has a valuable monopoly.

3M's current advertising warns that any plastic tape cassette accumulates a static charge of up to 20 000 volts.

This makes it a magnet to dust and stops the tape running freely because the tape sticks to the cassette. If dust gets onto the tape, it will cause sound and picture blemishes because the recording heads will try to work with dirt instead of magnetic particles. The new process, claims 3M, reduces the charge to 100 volts.

3M has until now kept the technology secret, but the patent shows that the invention is only a short step from known technology.

Patent information

Copies of patents, which contain fuller details and the addresses of inventors, are available from science reference libraries around Britain. For details of free public access and

purchase price, contact the London Patent Office and Science Reference Library at 25 Southampton Buildings, London WC2A 1AY (Tel 01-405 8721).



Pedal power

THE US Patent office, usually careful about accepting perpetual-motion machines, has granted a patent (4 568 096) to Anwar Farooq of Louisiana on an idea which is only a hair's-breadth away.

The Farooq bike looks normal, but has an air intake in the front. As the bike moves forward under pedal power, air is pushed through a compressor which pumps air through the hollow frame. Pressure inside the frame builds up until the air opens a one-way valve near the back wheel. The vented air hits a turbine fixed to the back wheel, and the turbine helps to turn the wheel. "This," says Farooq in his patent application, "provides forward motion without pedalling."

It does, but only while there is still some energy stored because of the extra hard pedalling needed to both propel the bike and to compress the air. Energy stored in the wheel by free wheeling down hill is not free either; the cyclist has to pedal to the top of the hill first.

Farooq reassures riders that they will be able to stop in an emergency by venting the compressed air in the frame to the atmosphere through a blow valve.

Static can be cured by making the offending material conduct electricity, so that the charge leaks away as fast as it is generated. Previous antistatic treatments have involved mixing a conductive material with the plastic at the time of manufacture.

According to 3M, this approach is wrong. The right approach is to coat the material with an electrically conductive, organic material after manufacture. Almost any antistatic material will do, for instance an ionic salt or an amine. The trick is to coat as much of the surface area as possible, both inside and outside the cassette. The thickness of the coating does not much matter.

Barry Fox

A bracelet for an avalanche

A SULAB, a Swiss company, has filed European patent applications on an idea which could save lives after an avalanche.

The easiest way to find someone under the snow is to listen by directional radio for transmissions from emergency beacons. The difficulty is that the emergency transmitters must be battery-powered, which makes them bulky. Skiers do not want to carry heavy beacons. Also if the beacon automatically transmits a signal all the time, the batteries may be flat by the time help is within receiving range. And if the beacon is designed so that, in an emergency, it has to be switched on, the person under the snow cannot know when it should be activated.

European patent 172 445 suggests what looks like a fool-proof answer. Everyone at risk in a mountainous area will wear a bracelet, like a watch strap.

The bracelet is a passive transceiver which has an aerial made from metal foil but no batteries and no conventional transmitter. Instead, the bracelet foil acts as a receiving aerial for search signals transmitted by a rescuer who is carrying a radio backpack.

The search signals are strong enough to generate a current in the bracelet, like an old-fashioned crystal set. This current flows through a non-linear circuit which halves or doubles the frequency and re-broadcasts it with the same foil aerial.

The rescuer listens for signal echoes at a different frequency, and uses a directional aerial to pinpoint their source. Others in the team can then dig through the snow.

The passive beacon works automatically, even when the wearer is unconscious, and goes on working for as long as there are rescuers in the area, because it has no batteries to wear out. Bracelets could also be worn by anyone living in earthquake zones, and by people involved in dangerous sports, such as potholing.

Power from the people

Hundreds of people have discovered that generating their own electricity and heat from small machines saves money. The new technology could change the whole structure of generating electricity in Britain

Dave Andrews

IN FEBRUARY this year, the headquarters of the Devon and Cornwall police force in Exeter switched on a generator that converts energy three times more efficiently than Britain's generating authorities do. The device has no big secret—it is simply an engine fuelled by natural gas which drives a generator. Waste heat from the engine heats water for showers and a swimming pool for trainee police officers. Such machines, known as minichips (for miniature combined heat and in-house power) could change the way we use energy.

The machine at Exeter is the largest example in Britain of a plant that generates combined heat and power (CHP) for a single building. Surprisingly, generating on a small scale consumes energy more efficiently than giant power stations do, and also saves money for the machines' owners. Despite the cost of buying a minichip, the machines are cutting the costs of electricity at around 200 hotels, factories, municipal buildings and hospitals in Britain.

Most of the electricity generated in Britain comes from power stations which produce hundreds of megawatts of electricity from the heat produced by burning coal or a nuclear reaction. This heat boils water into steam, which in turn drives turbines connected to generators. The efficiency of a thermal power station (the percentage of energy in the fuel going into the energy in the electricity produced) is around 31 per cent. The rest of the energy disappears as low-level heat, usually from cooling towers. On top of that, generating authorities lose another 3 per cent because of electrical resistance in power lines and transformers. Thus the electricity that reaches a consumer carries only 28 per cent of the energy in the original fuel.

For years, people have said: "Why not pipe waste heat from power stations into buildings?" Schemes to combine heat and power are technically proven, and common in countries such as Sweden, where one quarter of the country's homes receive heat from power stations. The Department of Energy in Britain has said it wants to test combined heat and power on a large scale in cities such as Belfast, Edinburgh and Sheffield, by setting up networks of pipes to carry heat from power stations into people's homes. The problem is the cost of such networks. In Britain, progress has been at a snail's pace (*New Scientist*, 16 August 1984, p 26). While the government delays, millions suffer from cold homes.

Opting for combined heat and power does not necessarily mean building vast schemes to pipe heat from power stations into entire districts. A machine such as the one at the police headquarters in Exeter puts the technology on a far less cumbersome scale. The electricity comes from a generator driven by a reciprocating engine similar to a car engine. A system of heat exchangers recovers heat from the engine's cooling water and exhaust system. Minichips can be integrated to deliver water at temperatures of up to 80°C.

Small minichips have an electrical efficiency of 25 per cent; larger ones an efficiency of 35 per cent. But in a combined heat and power system, heat does not go to waste. Small minichip machines turn 65 per cent of the energy in the fuel into useful heat. Thus the machine's overall efficiency is 90



per cent, three times that of a conventional power station. The machine in Exeter produces 134 kilowatts of electricity and 267 kW of heat.

The way to tap a minichip's full potential is to connect its electrical output in parallel with the supply from the electricity board. Normally, an engine runs at full power for 15 hours a day. Every unit of electricity the machine generates saves its owner money. If the owner needs less electricity than the machine produces, the surplus current flows back into the national grid. This is called exporting electricity. In Britain, electricity authorities have by law to pay for the electricity they receive. The 1983 Energy Act obliged Britain's electricity authorities to "support and assist" the introduction of combined heat and power wherever possible. In practice, some area boards are

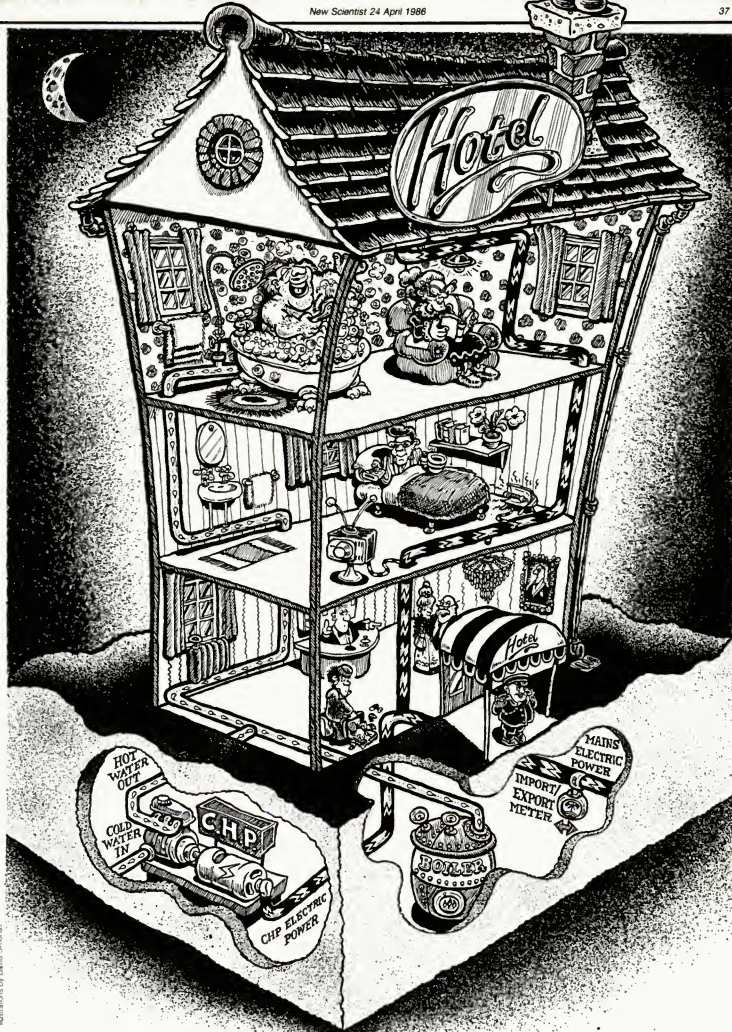
more helpful than others in paying realistic prices for the electricity they buy. (Exporting electricity can have strange consequences. Ordinary electricity meters simply reverse direction when electricity flows back to the grid, to the amazement of meter-readers. People who want to export significant amounts should fit special meters to record it.)

The first decision to make when fitting a minichip is what size of machine to buy. The best is one that will produce enough heat to meet the building's normal load during the summer. In winter, ordinary boilers can meet the extra demand. Thus, the minichip provides the "base load" of heating. In practice, although a minichip may be capable of producing only one tenth of the boiler's peak output, it may provide 60 per cent of the heat produced over the whole year. To ensure that the minichip can run for as much time as possible instead of the less efficient boilers, the building must have some way of storing hot water.

In suitable buildings, minichips of this size will run for between 4000 and 8000 hours a year, and pay for themselves within two or three years. It is a bad idea to choose a machine to meet the building's need for electricity. It is far better to treat the electricity as a by-product, to be consumed in house or exported as required.

The machine at Exeter was designed and developed in Britain, and has at its heart an industrial gas engine made by the company Waukesha (pronounced wockashore) in the US. This type of engine has been developed over the past 50 years to run continuously, reliably and with low maintenance costs. Industrial gas engines normally find applications in arduous environments such as offshore oil installations, often fuelled by gases coming from the well.

Industrial gas engines can run generators producing between 16 kilowatts and 2.5 megawatts of electricity. Although similar to normal automotive engines, gas engines are much more heavily built, with larger bearing surfaces, and they run at lower speeds. Gas engines are generally designed for long life and ease of maintenance rather than to provide, as a car engine does, a high ratio of power to weight. Many smaller minichip machines have car engines. They are less robust than industrial engines, but running on gas at a fixed speed, car engines are still more reliable than identical engines in cars. ▶





Engines fuelled on gas and running at steady speeds can last for a very long time. Several British minichips with car engines have run for more than 20 000 hours, which is equivalent to driving a car 1.6 million kilometres without a rebore! Two engines that Waukesha built have run 12 hours a day in Norfolk for the past 18 years. Waukesha's president says that one of the company's engines in the US has run for 12 hours a day since 1935. New types of engines might perform even better. In one system, a rotary Wankel engine drives a generator rated at seven kilowatts. I have seen a Stirling external-combustion engine that has run for 14 000 hours (18 months) with no maintenance. Gas-turbine engines, however are uneconomical for heating buildings, and diesels cost too much to buy and make too much noise to fit in buildings.

Noise should not be a problem with a properly insulated gas engine. In one installation, when people complained about the noise, the culprit turned out to be new gas boilers rather than the minichip's engine.

The technical advance that has made combined heat and power possible on a small scale is the ability to control an engine and generator automatically with microelectronics. There is no point in saving money on electricity bills if it costs

more to employ someone to run the machine. Every minichip has two sets of controls. One, like a normal control for a central heating system, starts up the engine, or the back-up boiler, in response to the demand for heat in the building. The second control system ensures that everything is healthy—electrically and mechanically—before the engine starts up and the generator connects to the grid.

If the voltage, current output or frequency of the generator or grid, or any of the engine's parameters, such as oil pressure, vary outside preset limits, the engine automatically shuts down and the generator disconnects. This second control panel ensures the safety of the plant itself, and of the electricity board's plant and employees.

Generators smaller than about 40 kilowatts are usually asynchronous—that is, they do not have equipment to synchronise their output with the frequency of the National Grid. The electrical output of such generators is inevitably of the same frequency as the grid. Larger machines, with synchronous generators, have automatic synchronising gear. Although these systems are more complex, they have a variable output of electricity. This means they can act as standby generators, for use in power cuts. The machine at Exeter is of this type. During power cuts, it can provide anything up to 134 kilowatts of electricity. When the mains electricity comes back on, the generator resynchronises and is connected automatically back to the grid.

Many different types of buildings are suitable sites for minichip machines. Among them are hotels, halls of residence in universities, prisons, swimming pools, leisure centres, boarding schools and industries which need a year-round supply of low-temperature heat. The machines can pay for themselves very quickly, in less than two years in some cases. As a guide, a hospital or hotel with 100 beds will usually need a system rated at 40 kilowatts of electricity. A large municipal swimming pool might need three such machines. Micro CHP is not, at the moment, suitable for heating space only. Running a machine only in the winter would double the time taken to recoup its cost.

Equipping all suitable large buildings in Britain with minichip plants would create about one million kilowatts (one gigawatt) of capacity in electrical generating. This is about 4 per cent of the Central Electricity Generating Board's output. But this is not the limit of the technology's potential. Minichips could also supply heat and electricity to homes. Several houses would have to share a single engine, with insulated pipes running underground to distribute the hot water. A study by the Open University's Energy Research Group shows that a system producing 40 kilowatts of electricity could heat 50 houses, saving each house £85 each year in fuel bills. The machine would pay for itself in five years. There are some 22 million dwellings in Britain. Giving each one a kilowatt share in a minichip plant would create 22 gigawatts of electrical generating capacity. The Central Electricity Generating Board produces on average at the rate of about 25 gigawatts.

Of course large power stations generate electricity more cheaply than thousands of small machines. Or do they? In

Why CHP is more difficult than it sounds

OVER THE PAST 10 years, committee after committee of experts has backed the expansion of combined heat and power in Britain. Despite the consensus, the country still wastes something like the equivalent of 14 million tonnes of coal in heat each year.

Last year, the government agreed to spend £250 000 on studying the feasibility of CHP at three British cities—a tiny fraction of what is needed.

CHP enthusiasts often feel like victims of a conspiracy. This is unfair. The warm air

that disappears up the cooling towers of thermal power stations ranges in temperature between 12° C and 30° C. This is too cold to be much use. Heat pumps, which work like refrigerators in reverse, can turn this low-grade heat into hot water, but are expensive to buy and cost money to run.

More feasibly, the generating turbine can be adjusted so it expels steam at a temperature of 80° C or so. But this reduces the power station's efficiency.

The next problem is to pipe heat into

people's homes. Piping is by far the highest cost of conventional CHP scheme, although new plastic pipes might cut the cost. Private investors would probably not be able to raise the money.

Despite the inertia, there are signs of progress. One way to use energy more wisely would be to burn refuse to generate electricity and heat. According to the group **WARMER**, which is campaigning for a change, Britain wastes £1 million a day by dumping rubbish instead of burning it. □

fact, the costs compare very favourably. Combined heat and power is intrinsically a more efficient way of converting fuel than normal generation, but the precise costs depend on the individual situation. Let us look at two cases.

The first is in a building equipped with a modern boiler. Modern heating systems may have a high efficiency (in winter), of around 80 per cent. A minichip unit is not so heat-efficient, converting only around 65 per cent of the fuel's energy into useful heat. Therefore, substituting the minichip will increase the amount of fuel consumed to create the same output of heat. But minichips produce electricity, too. This electricity thus has a "fuel cost" of about 0.85 pence per kilowatt-hour. Adding in maintenance costs of around 0.5p per kilowatt-hour over the 25-year life of the machine gives a marginal electricity price (excluding interest payments on the capital cost) of 1.35p per kilowatt-hour.

In the second example, a minichip can replace an existing low-efficiency heating system. If the seasonal efficiency of the old boiler is less than 65 per cent (the case for most domestic and institutional boilers in Britain), the electricity the minichip generates could be said to cost nothing in fuel. Our marginal electricity cost would then be less than 0.5p per kilowatt-hour. Electricity from conventional power stations costs roughly the same in running costs. The Central Electricity Generating Board gives figures of 1.2 pence per kilowatt-hour for electricity its nuclear stations generate, and 2.8p per kilowatt-hour for new coal-fired stations.

We must also look at capital costs. Minichips cost about £500 per kilowatt of electrical capacity, including installation. This is slightly cheaper than coal-fired power stations. Nuclear stations are very expensive, about £1000-£1500 per kilowatt of installed capacity. The precise cost of nuclear electricity depends largely on the rate of interest charged on this large capital investment.

Thus, small-scale combined heat and power costs less, in

both capital and running costs, than ordinary coal-fired power stations do. It has lower capital costs than nuclear stations and given the right circumstances, lower running costs as well.

Small-scale CHP could produce a significant amount of the electricity consumed in Britain, without greatly increasing the amount of gas burnt. There are already 200 such installations in the country, with a total electrical output of five megawatts. The Netherlands, which has a quarter of Britain's population, has 600 minichips.

One reason for Britain's slowness to adopt combined heat and power has been that public and private authorities differ in deciding an acceptable rate of return for an investment. Private companies believe five years to be a long time to wait for their money back. But the Central Electricity Generating Board has to make only a 5 per cent return on its capital (after allowing for inflation). This is equivalent to a pay back time of 15 years on long projects.

Privatising the electricity supply industry might change its attitudes to interest rates. If it did, CHP's competitive position would improve—at a cost of unacceptably dearer electricity. A better solution would be to strengthen the 1983 Energy Act. It could require Britain's area electricity boards to install small-scale CHP systems in certain well-defined places. In the Netherlands, it is now common for an electricity board to install a minichip, to operate it, and sell the heat to the host building at a lower cost than previously. If the building no longer needs the heat (a factory may close or move), the minichip can simply be carted off and installed somewhere else. Perhaps the day will come when we do not buy electricity, but rent a power station. □

Dave Andrews is an area manager with Applied Energy Systems of Watford, England. He has done research on combined heat and power for the Open University's Energy Research Group.



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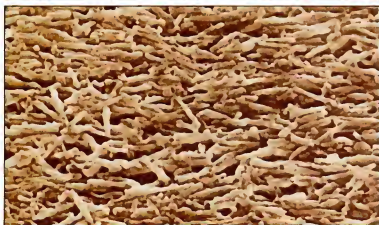
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Japan has digital recording taped

Digital audio tape will do for conventional magnetic tape what the compact disc is doing for the black vinyl LP

Barry Fox



Manufacturers use smaller particles to coat magnetic recording tapes today (bottom right) than those they used 10, 20 and 30 years ago. Smaller particles allow more faithful sound reproduction, but the metal tape that digital audio tape uses is even better

THE BALANCE of power in the technology of sound recording is shifting from West to East. Magnetic recording was invented in Europe, improved in the US and plagiarised in the Far East. The launch later this year of Japan's latest electronic invention, digital audio tape or DAT, will change all this. The new system will clear Japan's few remaining technological debts to the West.

For 20 years, the Japanese electronics industry has been obliged to follow the recording standards set by Philips and make equipment compatible with the standard "compact cassette". Now, DAT is about to do to tape manufacturers in the West what the Japanese electronics industry has already done to most manufacturers of television and audio equipment in Europe and America. DAT offers a single standard for all tape recording from domestic hi-fi and portable Walkman through to the professional studio workhorse. Sony has already secretly shown prototypes to broadcasters round the world, including the BBC.

DAT's advantages are many. A DAT cassette is smaller than the conventional audio cassette, but it offers several hours of continuous stereo sound that is as good as that from a compact disc. The system needs no noise reduction to eliminate background hiss. Digital recording for high-fidelity audio relies on sampling the electrical analogue of the sound wave at least 30 000 times a second, and converting the successive values to numbers. These numbers are then

recorded onto tape. During playback, the cassette player converts the recorded numbers back to analogue form. On conventional analogue recordings, particles on the tape cause background noise; with DAT, provided the system can recognise the digital information on the tape, the presence of particles does not affect the quality of the sound. DAT makes noise-reduction systems, such as Dolby and dbx, obsolete.

Because DAT records music in digital code, it can also simultaneously store data and computer programs. This ability allows DAT to display text and graphics on a television screen, or to print the data on the tape when coupled to a suitable machine. Radio stations, for example, will be able to obtain a printed record of the music broadcast in a programme direct from the digital code on the tape. This facility would greatly simplify payments made for copyright. It might also be possible to make DAT players compatible with home computers.

DAT relies on similar technology to an earlier Japanese development, 8-millimetre video. The cassettes for 8-millimetre video, which is already on sale, are smaller than a conventional audio cassette, yet one cassette can record three hours of colour television in analogue simultaneously with digital stereo sound. Other video formats (VHS and Beta) use 12.5-millimetre tape in much larger cassettes and cannot record digital audio as well as analogue pictures.

Both DAT and 8-millimetre video rely on tapes that can

New and old ways to make metal tape

THERE ARE two ways to produce metal tape: either coat a plastic film with metal powder (MP tape), or evaporate the metal in a vacuum so that the vapour deposits itself on the plastic film. The second method gives rise to ME tape, for metal evaporation.

So far, only MP tape is available commercially—for analogue recording and the new 8-millimetre video system. ME tape has proved difficult and expensive to mass-produce, but the recording industry perseveres because the ME coating is so thin—less than 0.5 micrometres thick. A cassette can hold nearly twice as much ME tape as conventional tape, so a tape could play for twice as long, or store twice as much data.

ME tape also allows recording using conventional heads: the coating is so thin that it needs only a weak signal to magnetise it. However, because the tape's coating is so thin, it cannot record low frequencies well, and so cannot reproduce analogue sound with high fidelity. Thus, if the faithful reproduction of the sound is important, it is preferable to record it on MP tape.

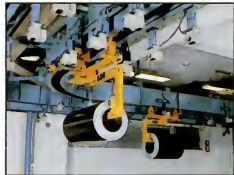
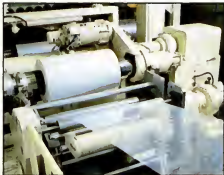
MP tape, with a thicker coating than ME tape, needs a head made from a magnetic material which will not saturate with its own flux before the tape records a signal. Only amorphous metal or Sendust alloy (iron, aluminium and silicon) can cope, but both materials are difficult to make and fashion into heads (Box 2).

Philips and 3M were the first companies to make MP tape in the 1970s. Sound engineers start by producing acicular (needle-shaped) particles of iron by reducing iron oxide or sulphate in the presence of a catalyst. They then apply the metal powder, in the same way as they would apply a conventional oxide coating, by running a plastic film through a bath of particles and resin binder in a solvent. The resin binder seals the particles of metal, to stop them rusting to nonmagnetic oxide

when stored or used in a humid atmosphere.

ME tape is much more difficult to make. In 1979 Matsushita in Japan announced that it had successfully deposited a thin film of cobalt-nickel alloy on a plastic film in a vacuum. The metal layer can capture very

kilometres per hour. The trick is to get the boiling metal vapour to bond with the plastic without destroying it. A high-voltage discharge first erodes the plastic to create a key for the metal vapour as it settles on the film. The film moves over a rotating metal drum containing liquid freon at -100°C .



TDK produces tape in dust-free rooms using fully automated equipment. Rolls of blank film feed into machines that will coat them with a magnetic material (left). Coated rolls travel back to the warehouse on a computer-controlled conveyor belt

short recorded wavelengths, because it is not made up of particles. Such a smooth structure means that there are no particles to limit the size of the recorded wavelength.

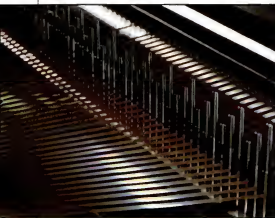
Matsushita's investment in research into the technology of ME tape is already paying off. The company heavily patented the production process and has now licensed BASF of West Germany, 3M of the US and most Japanese companies to make ME tape. Each company has its own highly secret know-how.

TDK in Japan uses a vacuum chamber, around 10 metres tall, which opens like a clam shell to receive a large roll of plastic film, 27.5 centimetres wide. The "shell" closes and the air is pumped out. An intense beam of electrons scans a block of nickel-cobalt alloy, turning it into a metal vapour which fills the vacuum chamber. The base film spools through at up to 10

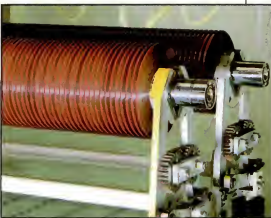
The hidden snag, which engineers talk about only when asked, is that the boiling metal vapour fills the chamber and deposits on the walls as well as the tape. It takes up to an hour of work with a hammer and chisel to chip it free.

The end result is a large roll of plastic, 7 micrometres thick, with a pure layer of metal 0.1 micrometres thick. It takes an hour to coat the roll, an hour to pump the vacuum and another hour to clean up the chamber.

One roll yields only around 900 cassettes. "Compared with metal powder tape," says Hideki Hotsuki, general manager at TDK's research and development centre, "we have to admit that cost-to-performance ratios are not so good." One estimate is that ME tape will cost up to ten times as much as MP tape, which already costs twice as much as oxide tape. □



TDK's machinery splices the coated tape to blank leader tape, and slits the huge rolls to the desired width—3.81 in the case of tape for audio cassettes. Each "pancake" of slit tape holds enough for 25 C-60 cassettes



record large amounts of data in a small area—in other words, these tapes have a high signal density. In conventional magnetic tapes for recording sound or pictures, the signal density depends on the smallest change or transition that the medium can resolve per unit of length. Sound engineers refer to the effect of these transitions on the magnetic particles as the recorded wavelength. The shorter the wavelength that the tape can record, the more data that it can hold. For analogue

recording, the signal transitions are discrete fluctuations in the waveform of the signal. For digital recording, the transitions are pulses or square waves which signify ones or zeros. Thus the resolution of both analogue and digital signals is directly related to the shortest wavelength which the magnetic medium can capture.

Recorded wavelength depends on two factors: the size of the magnetic particles on the tape, and the speed at which

the tape passes the recording head. Just as light cannot resolve detail smaller than its wavelength, particles cannot record a wavelength smaller than their dimensions. The speed of the tape past the heads affects recorded wavelength as follows: a musical note at a frequency of 15 kilohertz has a recorded wavelength of 3 micrometres on a conventional cassette tape running at 4.75 centimetres a second. Halve the tape speed and the recorded wavelength falls to 1.5 micrometres, which is impractical for current domestic hi-fi. Doubling the tape's speed doubles the recorded wavelength to 6 micrometres.

The tape developed for 8-millimetre video can record a wavelength of 0.75 micrometres even when the tape passes the rotating recording heads at the slowest speed of 1 centimetre a second. To achieve this level of performance, the Japanese had to overcome several problems associated with conventional tape. For example, the individual particles that coat the tape colour the desired signal with random noise. In an analogue sound recording, these particles cause background hiss. On tape passing through a digital decoder, they confuse the machine into reading ones for zeros or vice-versa. The noise gets worse if the particles are of uneven size. Modern conventional tapes have acicular or needle-shaped particles of very consistent size.

The particles on the tape change magnetic polarity when they record signals, but if the particles are very small—as they need to be if they are to register small transitions in the recording signal—they tend to demagnetise one another. The solution to this problem is to use material that needs a strong magnetic field in order to change its state. The measure of the strength of the magnetic field needed to return a magnetic material from saturation to zero is called coercivity. The recording industry measures this property in oersteds (multiply by 79.58 to convert to amps per metre). Coercivity has increased considerably throughout the history of magnetic tapes, as tape manufacturers have used smaller particles in coatings, and as recorded wavelength becomes shorter.

The high-quality tapes most commonly used in audio and video recorders have a coating of either chromium dioxide or "pseudochrome"—ferric oxide with a little cobalt. These coatings have a coercivity of up to 700 oersteds. Both chrome and pseudochrome have now gone far as they can. They cannot offer the much higher coercivities, of around 1500 oersteds, which are needed for 8-millimetre video and DAT. The limit of their recorded wavelength is 1 micrometre. Both 8-millimetre video and DAT need a new type of tape, which overcomes the problems of the size of particles and the need for high coercivity. The new tape is based on pure metal.

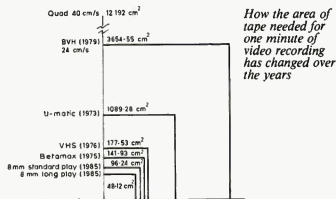
There are two ways of making metal tape. One method is to coat a film of plastic with acicular particles of pure metal powder; another is to evaporate the metal in a vacuum so that the vapour deposits on a chilled plastic film (Box 1). It is easy to achieve a coercivity of 1500 oersteds. The new 8-millimetre video system already relies on metal tape.

Metal tape has broken the micrometre barrier. The signal density on 8-millimetre video tape is now greater than on any other recording medium. Recorded wavelength is 0.75 micrometres and the tape is running at only 1 centimetre a

second. In other words, if the tape were as wide as the English Channel (32 kilometres), the recorded wave would still be only the length of a tiny boat (3 metres).

On 8-millimetre video tape, the signals needed for one minute of colour television and digital stereo sound occupy just 48 square centimetres of coated tape. By comparison, one minute's recording on a VHS tape occupies 180 square centimetres. The first video recorders used by the broadcast industry 30 years ago needed 12 000 square centimetres of tape for a minute of black-and-white pictures with mono sound.

Digital audio tape is a direct development from the technology of 8-millimetre video. Both rely on equally short recorded wavelengths. There are two DAT standards. On one, S-DAT, the recording head remains stationary. In the other, R-DAT, the recording head rotates rapidly, like the head in a video recorder, while the tape moves slowly by. Sony, and other manufacturers of video recorders, prefer R-DAT because its rotating head requires the kind of precision engineering they are good at. R-DAT is a spin-off from video recording where the tape moves slowly and the recording heads move rapidly to scan narrow tracks across



How the area of tape needed for one minute of video recording has changed over the years

the tape's width. No one is yet sure which DAT standard will go on the market, though R-DAT looks like winning. The tape for both S-DAT and R-DAT is the same width as the tape in a conventional audio cassette, 3.81 millimetres. But DAT cassettes are smaller and more like video cassettes.

In an S-DAT recorder, the tape runs at 4.75 centimetres a second past a stationary recording head. The head is divided into 22 separate sections by photo-etching a pattern onto thin metal film. Each of the 22 divisions records its own track along the tape. The recorder converts the sound into 16-bit digital "code-words". It then spreads the bits across as well as along the 22 tracks which means that the machine can apply a mix of serial and parallel processing to play back the data. This processing transmits data at a rate of 2.4 megabits a second on record and playback.

An R-DAT machine feeds the 16-bit code words serially to the recording head. The head is on a drum, 30 millimetres in diameter, which rotates at 2000 revolutions per minute. The tape runs along a 90-degree section of the drum's circumference, at a speed of 0.9 centimetres a second. The recorded

2: New magnetic materials for recording heads

UNTIL 1980, recording heads were made of iron alloy or ferrite, which have a low magnetic saturation point—they become fully magnetised very easily. A new alloy called Sendust has twice the capacity for magnetism than ferrite has.

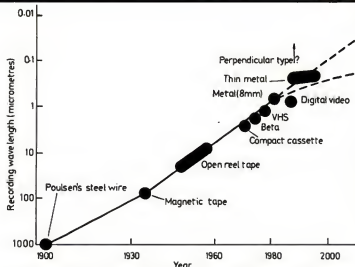
Sendust is an alloy of iron, aluminium and silicon, named after the Sendai region of Japan. Recording engineers make the heads by compressing dust into the precise shape required. Sendust is brittle and tends to rust, but if it is mixed with chrome to

prevent corrosion, its magnetic characteristics spoil.

Sony makes the main body of the recording head for its 8-millimetre video recorders, which use tape of 1500 oersteds, from tough ferrite. A thin layer of Sendust covers the tip, where the magnetic flux is concentrated. The quality of pictures available from 8-millimetre video is still improving almost daily, as Sony tinkers with the head tip and the coating on the tape.

The alternative approach is to make the

recording head from amorphous metal. Amorphous metals result from freezing the molten metal at a rate of around one million degrees Celsius per second. At this rate of cooling, most metals solidify in a fraction of a second into a non-crystalline structure. Amorphous metals resist corrosion and they can handle high levels of magnetic flux without themselves becoming fully magnetised. Unfortunately, heads of amorphous metal are difficult to make, and expensive. □



New technology has made it possible to record shorter wavelengths, providing longer playing time and better sound reproduction.

tracks lie obliquely across the tape, like the helical threads of a screw. The tracks are only 15 micrometres wide, which is narrower than those on any conventional video tape and a quarter the width of a human hair. The head, when it plays the tape, must follow these tracks accurately. This is where precision engineering becomes important: the drum spins the head across the tape at 2-46 megabits a second and its recorded wavelength is 0.7 micrometres.

Such recording techniques mean that DAT has a hidden benefit for the music industry. Conventional musicassettes must be mass-produced by playing one tape and recording its output onto many others. DAT copiers mass-produce cassettes by a sandwich technique. The copier places a master against a blank tape and the digital code "prints" magnetically from one tape to the other. Analogue audio signals will not transfer in this way. Transfer of the digital code works better when the tapes sit in a strong magnetic field created by a direct current or if the tapes are hotter than 100° C. Under these conditions, the tape's magnetic properties change so that copies appear as fast as two tapes can wind into a sandwich together and then unwind. Sony has demonstrated that a magnetic transfer machine works 200 times faster than a conventional tape copier.

Recording engineers are already looking for even higher signal densities than those achieved with 8-millimetre video and DAT. One tape manufacturer, TDK, says that the theoretical limit to the size of a recorded wavelength is around 0.25 micrometres. Even the slightest movement of the tape away from the head causes so much loss of the signal at these wavelengths, and errors in decoding the bit stream, that it renders a digital system useless. Engineers at the BBC found that a fingerprint on a digital tape separates the magnetic coating from the head by 2.5 micrometres. At a

recorded wavelength of 1-25 micrometres, this would reduce the signal by 100 decibels. This is equivalent to reducing the signal strength by a factor of 100 000.

If the magnetic particles on a tape are too small and too tightly packed, in an attempt to record shorter wavelengths, they will demagnetise each other and record nothing. Acicular particles on a conventional tape lie flat on the plastic backing. The next development in tape technology will be "vertical recording"—acicular particles that stand upright, at right angles to the backing. The analogy is with the Isle of Wight, which can hold the world's population, provided that everyone is standing. In a vertical medium, the tendency for the particles to demagnetise each other is significantly reduced and recording density increases by a factor of at least ten. Such tapes will be difficult to make, however, as long thin acicular shapes do not naturally stand on end. To use tapes with vertical particles, sound engineers will also have to modify the heads they use to record and playback to create a perpendicular pattern of flux rather than a parallel one. The easiest way to achieve a vertical pattern of flux is with a head that has one part on each side of the tape or disk.

Such techniques are more likely to lend themselves to computer disks than audio or video-cassette tapes, however. Computer technology lags far behind video and digital audio in recording density: one bit on a high-density floppy disk for a personal computer is 5 or 6 micrometres in size. Although 8-millimetre video and DAT rely on wavelengths below 1 micrometre, the computer industry dare not rely on such high densities of signals. Loss of a signal on a video or audio tape means either a flicker on the screen or a barely audible distortion of the sound. The same error on a floppy disk could introduce an extra zero in numerical data and play havoc with financial records, for example. The personal computer industry will soon introduce CD-ROM, a compact disc with 600 megabytes of read only memory instead of stereo music. Alongside this capacity, the conventional magnetic floppy disk that holds 1 megabyte becomes an inadequate tool.

Several Japanese companies, including Maxell, have shown how to double or treble the recording density by coating a floppy disk with pure metal powder instead of metal oxide. Coercivity increases from the normal value for a floppy disk of around 650 oersteds, to 1500 oersteds. This improvement enables it to store more data—17 000 bits per centimetre in comparison to around 3000 digital bits per centimetre. The extra signal density available with metal coatings does have a snag. The magnetic particles need a stronger flux to switch their magnetic state than particles in a coating of metal oxide, making it harder to record. Existing computer heads cannot provide a strong-enough flux. They saturate themselves with a magnetic flux before they record onto a metal-coated disk, and overload when they replay from it, creating false signals. These disks are not compatible with existing computer hardware.

Instead of ironing out such problems, the computer industry is more likely to make the jump to vertical recording, and the much greater facilities for storing data that it offers. Computers already use double heads in disk drives—one to read each side of the disk. A computer operator slides a disk into the drive and between the two halves of the head. It is also easier to coat a disk than a tape with vertical particles: a disk sits still in a vapour deposition chamber, while a tape picks up a magnetic coating as it passes through a liquid bath. When computers start to handle disks with vertical magnetic particles, disks that can take a higher signal density than any tape will become common. NHK, the Japanese broadcasting company, is exploring the implications of metal-coated disks for video. It has succeeded in recording several minutes of colour video on a floppy disk coated with perpendicular particles of cobalt alloy.

The home computer of the future will not only compute and read text from CD-ROM, it will record television pictures and digital stereo sound too. □



Sony briefly showed this prototype of an R-DAT machine at a seminar in Tokyo last October

Tigers in Western Australia?

Tasmanian tigers apparently went "extinct" when the last specimen died in Hobart Zoo in 1936. New evidence suggests that some may be alive and well and living on the mainland

Athol M. Douglas

EARLY in February 1985, Kevin Cameron, who lives at Girrawheen in Western Australia, shoved five photographs at me. He offered no comment, and his manner was almost aggressive. As I looked at the photographs, the identity of the animal in them was unmistakable. It was about the size of a dog, with dark bars across the rump and a thick base to its tail. I realised that without doubt Kevin had found the Tasmanian tiger, or thylacine, alive in the south-west of Western Australia.

The thylacine was once common on the mainland of Australia, but is thought to have become extinct thousands of years ago, probably as a result of competition with the dingo. It remained quite plentiful on the island of Tasmania which, we believe, separated from the mainland about 12 000 years ago. From the earliest days, in the 1830s, European settlers on Tasmania tried to destroy the thylacine because it killed their sheep. By 1850 fears were expressed for its survival, but nevertheless the Tasmanian government introduced a bounty scheme in 1888. Over the following 21 years, before the last bounty was paid, 2268 animals were killed and officially accounted for.

The last known wild thylacine was captured in Tasmania in 1933. It died in Hobart Zoo in 1936. D. E. Rounsevell, the zoologist who wrote on the thylacine in *The Complete Book of Australian Mammals* (editor Ronald Strahan, Sydney: Angus & Robertson, 1983), commented: "It is ironic that the thylacine was not protected by Tasmanian law until 1936, by which time it was probably extinct." Since then, there have been many supposed sightings of the thylacine and several intensive and comprehensive searches, but no proof of its survival in Tasmania, let alone on the mainland.

Accepted scientific knowledge is thus completely against Kevin Cameron, but he has a set of five photographs taken in dense forest in the south-west of Western Australia, and some casts of the animal's footprints. The scientists may be incredulous, but I believe Cameron's finds are authentic.

Kevin Cameron is of Aboriginal descent. He takes pride in his ancestry, his bushmanship, and his knowledge of Aboriginal culture. He is intelligent, but until recently was illiterate. So he could not have learned about the thylacine in libraries. I find it inconceivable that anyone with his background could possess colour photographs of a thylacine as well as the casts and his detailed and exact knowledge of the



animal, unless he had actually seen a thylacine.

The photographs are genuine. Dr Ronald Strahan, formerly director of the Taronga Park Zoo in Sydney and now at the Australian Museum, has also seen the pictures. He agrees with me that they are authentic and could be nothing other than a thylacine.

The first photograph shows the thylacine in the distance,

What is the thylacine

THE THYLACINE *Thylacinus cynocephalus* is a carnivorous marsupial about the size of a large dog. It stands about 60 cm high at the shoulder and measures between 100 and 130 cm from nose to tail. The tail is 50 to 60 cm long. The fur is coarse and sandy brown, with parallel dark bands across the back, increasing in width towards the rump. The head and forequarters are dog-like, the rump heavy and somewhat like a hyena. Females are slightly smaller and lighter in colour. Unlike dogs, the thylacine has five toes on the forefoot and four on the hind.

It is often referred to as the Tasmanian tiger, in reference to the stripes on its back and rump, but it is more apt to think of the animal as a marsupial wolf because its teeth, head and forequarters have a remarkably canine appearance. It is believed to hunt alone or in pairs, and, before the coming of European settlers and their livestock, probably fed on wallabies, possums, bandicoots, rodents and birds. It has been suggested that thylacines caught their prey by stealth rather than by giving chase. □



Last of the Tasmanian tigers? The Hobart Zoo specimen

with Kevin's discarded rifle in the foreground. The remaining four were taken at intervals as Kevin approached, the last being from only metres away. The thylacine was busily digging at the base of a tree, its head down behind the stump, and it was only because it was so engrossed that Kevin could get as close as he did. Although normally wary and alert, this animal was at a disadvantage because the stump obscured its vision, and the noise of its digging masked Kevin's quiet approach. It was only the click of the shutter on the final photograph that alerted the thylacine, which bounded away.

The photographs are not the only evidence Kevin has. He also showed me nearly perfect castings of footprints. These casts record structural differences between the front and hind feet that are typical of the thylacine. The forefeet have five toes and the hindfeet four, but the print-marks depend on the animal's gait at the time, whether walking or running. Kevin had casts of tracks made by stationary and moving animals. In one case, the tracks were made in damp soil and I could clearly see the impression of the five toenails.

Kevin also says that he has seen at least four separate animals on a number of occasions and that once his dogs bayed up a thylacine on a log. This animal was female and had a full pouch. He correctly describes the males as being darker than the females and, with the help of his dogs, sighted another pair in January 1986. He has tracked a thylacine hunting feral pigs, and he thinks that young pigs form a significant part of their diet.

Tasmanian tigers seem to resemble the larger genuine cats in their method of hunting. Leopards, tigers and cheetahs will often pull down an animal and choke it to death before tearing open the throat for a blood meal. They then eat from the head down into the body. Kevin has found kangaroo carcasses in the vicinity of his sightings; these show evidence of a similar feeding method. He has a photograph of a headless kangaroo, and it was around this carcass that he found

thylacine tracks. He says that he has never known a thylacine return to its kill. This too is recorded in the literature on the animal.

Kevin describes the gait of the animal as "warby". This is an Aboriginal word meaning drunk and erratic. It swayed from side to side and sort of hopped until it got into its stride, and then, he said, it outran his dogs.

This observation is almost identical to a description given by Dr S. J. Paramonov, a Russian scientist employed by the Commonwealth Scientific and Industrial Research Organisation. He saw a strange animal near the Warrego River in New South Wales, and recorded his observations in the *Western Australian Naturalist* (1967, vol 10, pp 171-172). Of the gait, Paramonov said: "The most remarkable feature was the strange manner of running: although the animal was swinging regularly sideways, the hindpart of the body made a kind of bobbing, up and down movement; the impression was as if the animal was drunk, as I had never seen anything like it. . . . Later, back in Canberra, I came across an illustration of the Tasmanian Tiger, and immediately recognised it as the animal I had observed on my trip."

Although he saw the animal in 1949, Paramonov did not publish his observations until almost 20 years later. He was prompted by the very exciting discovery of a decaying thylacine carcass in a cave on the Mundrabilla Station, about 110 kilometres west of Eucla in Western Australia. David Lowry, who found that beast, described it thus:

"The animal lay on its right side with its head raised off the ground. The skin and hair were largely intact on the exposed surfaces and the characteristic dark bars were clearly visible. The soft tissue had decomposed to a tarry substance which coated the bones . . . however the tongue and left eyeball were still recognisable and a musty odour of decomposition was noticeable. The tail was some 12 inches away from the rest of the body, probably moved there by murids (rats) which appeared also to have chewed the abdomen."

"Blowfly pupal cases and faeces (probably murid) were scattered around the carcass." (*Helicite*, vol 5, no 2, January 1967.)

The carcass is recent

The current received wisdom, based on radiocarbon dating and the fact that everyone knows that the thylacine has been extinct in Western Australia for thousands of years, is that the specimen found at Mundrabilla is some 4500 years old. Yet Lowry's description is of a very recent carcass, even down to the "musty odour" of decay.

I am not convinced that the carbon-14 dating is completely reliable. In limestone caves there is always the possibility of pollution by waters containing carbon from distant sources. The cave is near the Nullabor Plain, which is occasionally flooded, and there was definitely flooding on the Nullabor Plain and at the Mundrabilla Station in February 1960. Lowry noted that flood waters had disturbed the material near the entrance to the thylacine cave, and the carcass itself was in a clay-covered chamber, which indicates the former presence of water. I am certain that the carcass has been polluted with soluble carbonates giving a false carbon-14 date.

In the very same cave were found owl pellets and the remains of many other animals: rats, native cats, small reptiles, bats, snakes, a cat, dogs (possibly dingoes), rabbits, possums, kangaroos, wallabies, thylacines (five thylacine skulls with some fairly complete post-cranial parts), a wombat and a Tasmanian devil.

Most of these creatures were represented by disarticulated bones. Why then had the thylacine been preserved in such a fresh state? If the thylacine was preserved as a carcass, the modern animals would surely be in a similar state. Lowry states that "on 23 October, 1966 [when the carcass was discovered] the air temperature was 66° F and the humidity 67 per cent". The carcass in its present condition could not

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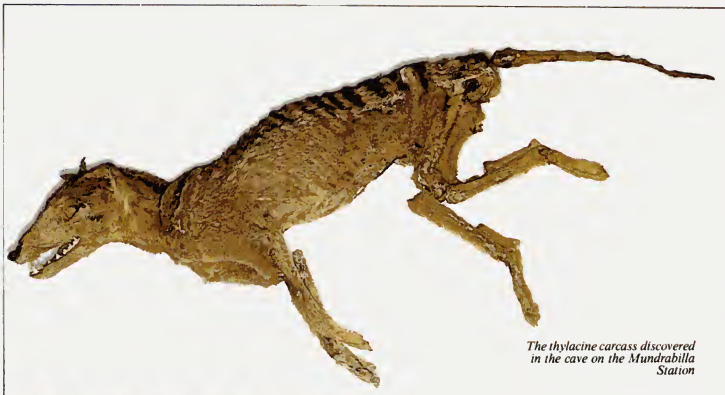
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The thylacine carcass discovered in the cave on the Mundrabilla Station

Turtles, Western Australian Museum



A kangaroo carcass, around which Kevin Cameron found the characteristic tracks of the thylacine

exist for more than 4000 years in a cave containing flesh-eating beetles and subject to high humidity and flooding. It must be relatively recent.

I have inspected the Mundrabilla thylacine where it is preserved at the Western Australian Museum. This investigation supported and strengthened my belief that the animal died in very recent years. It is a dried-out hollow shell, with no skin or hair on the underside. It is at the stage of decomposition where the action of bacteria and maggots has ceased, a stage I have observed in many similar carcasses of kangaroos, cats, dingoes and so on that I collected in mines and caves. While maggots and bacteria are active, most of the muscles and organs of the carcass are reduced to a fluid which drains into the soil below. This leaves a dry hide bearing some dried flesh, hair, sinews and cartilages supported by the skeleton. These remains are then attacked by the larvae of dermestid and trogid beetles and certain moths, leaving only the disarticulated bones of the skeleton.

This sequence is important, because although the museum's cleaning and fumigating process had removed any

invertebrate specimens, there were clear signs of attack by dermestid larvae. Parts of the pads, the nose and areas of the tail had been very obviously attacked by dermestid larvae, which often favour the base of the tail because there is so much sinew there. These recycling agents would surely have destroyed the carcass by now if it were 4000 years old.

Between 1965 and 1970, I was responsible for building up the Western Australian Museum's collection of comparative osteology. In this connection I examined very many animal carcasses at all stages of decay. I easily recognise the sequence and stages of decomposition, and that thylacine carcass I saw gave every indication of being subject to an ongoing infestation by dermestid larvae. The carcass is recent, and lends considerable support to Kevin Cameron's photographs and tracks of living thylacines.

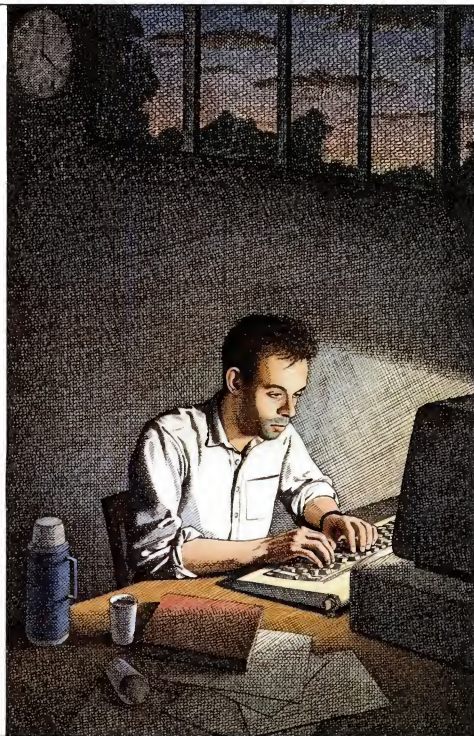
The sightings by Cameron and Paramonov of thylacines on the mainland are by no means the only ones. Many have been reported in the press, and they are often detailed and consistent with the known appearance of the thylacine. (A detailed history of the sightings can be found in *Carnivorous Marsupials*, editor. Michael Archer, Sydney: Royal Zoological Society of New South Wales, 1982.) But none has been buttressed with photographs and casts as Kevin's have. His ability to get within close quarters of these animals could be due to the fact that he is a first-rate bushman and has done all his searching on foot with his two superbly trained dogs.

What now? Kevin has suffered many adverse comments from people who prefer literature over personal observations. In the grand tradition of the old naturalists, he was even supplied with a high-powered hand gun to bring back a bloodied corpse. I have seen the receipt for the gun. However, this attitude has changed and Kevin is negotiating financial backing from the government and private individuals.

Before Kevin Cameron came to me, I was sceptical that the thylacine remained alive. After seeing his photographs, studying the casts, and questioning him about his observations, I have converted to a firm believer. I think Kevin Cameron has made the single most important wildlife discovery of this century. □

Atthol M. Douglas, now retired, was Senior Experimental Officer at the Western Australian Museum in Perth, Australia.

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Why study early human development?

A quarter of a million people in England and Wales suffer from infertility. It cannot be ethical to ban research that could let them have children

Anne McLaren

HOW MUCH does the woman on the Clapham omnibus or the average reader of *New Scientist* know about human reproduction? Most people know that it involves an egg shed from the woman's ovary and a sperm that fertilises the egg, and that this event may be followed a few months later by a fetus kicking in the uterus and then by the birth of a baby. But the picture of how the egg gets to be a fetus tends to be a bit hazy.

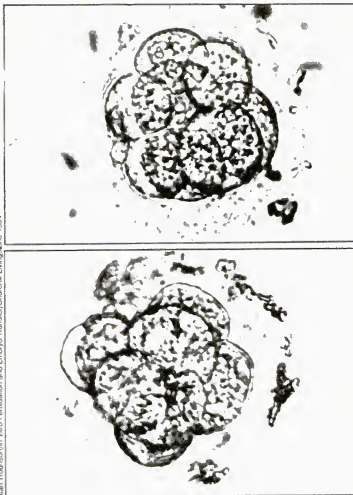
Much is hazy even to the specialist. A few decades ago, we knew next to nothing about how the inaccessible mammalian embryo develops. Now studies of animals are beginning to provide information, even at the molecular level, but much is still mysterious. A few years ago, only a tiny number of human fertilised eggs had ever been seen. Now tens of thousands are examined every year, and the pioneers of "test-tube babies", Bob Edwards and Patrick Steptoe, are more widely known than any other British scientists. Yet we still understand little about the early development of humans and why it so often goes wrong.

The first two weeks after fertilisation are essentially a period of preparation for the later development of the embryo. The fertilised egg divides once or twice a day for the first few days, to form a clump of cells which then spends about the next week burrowing into the wall of the woman's uterus. During this period of implantation, most of the cells become progressively committed to various tasks concerned with the protection and nourishment of the future embryo. Eventually they or their descendants form the placenta and the various other tissues that surround the embryo—chorionic villi, secondary yolk sac, primary mesoblast, amnion, allantois, and so forth.

At the end of the period of implantation, there remain some cells not involved in any of these life-support systems. It is in this group of cells (the "embryonic plate") that the so-called primitive streak appears, marking the place where the embryo itself finally begins to develop. Often the primitive streak fails to form, perhaps because too few cells are left or because the cells are abnormal. In that case no embryo develops. The woman's monthly period may be just a few days late, if at all, and usually she never even knows that the egg was fertilised. We do not know how many fertilised eggs fail to develop beyond this point, but it is probably well over half. Occasionally two primitive streaks may form on a single embryonic plate: this gives rise to monozygotic (identical) twins and represents the very latest stage at which twinning can take place.

Only at this point, 15 or 16 days after fertilisation, can individual embryonic development be said to begin. When the embryo first forms, it has no differentiated tissues or organs, no nervous system, and it is still very small (less than 0.5 millimetres along its longest axis). But it has a better than even chance of developing into a fetus and then into a normal healthy baby.

If this entity forming around the primitive streak is the embryo (as is generally agreed), what are we to call the entire collection of cells derived from the fertilised egg, of which the embryo is a tiny subset? In recent years, we researchers have developed the bad habit of calling the whole set of cells, at each prior stage, the embryo as well. To the non-specialist this is confusing, just as it would be confusing persistently to refer to the Shadow Cabinet as the Labour Party or vice versa. Other words for the totality of cells derived from the fertilised egg, prior to the appearance of the embryo, are conceptus,



An eight-cell pre-embryo, before (top) and after freezing. Research might lead to ways of screening such pre-embryos so that only healthy ones are transferred to the uterus

zygote, pre-embryo, and pro-embryo (see Henderson's *Dictionary of Biological Terms*, 9th edition, 1985). I shall use the term pre-embryo to refer to the first three major stages of development: the earliest stages of cell division (the so-called cleavage stages), the blastocyst (when the pre-embryo is a hollow ball of cells) and the stages of implantation up to the formation of the primitive streak.

The possibility of research on human fertilisation and early development arose when clinicians developed the ability to remove mature eggs from a woman's ovary by laparoscopy, and then fertilise them *in vitro* (IVF). Louise Brown, born in 1978, and all the other IVF babies owe their existence to years of research by Edwards and Steptoe on donated human eggs fertilised *in vitro* for purposes of research. Today, couples undergoing IVF can donate for research any pre-embryos in excess of the number that can be replaced in the uterus safely, without causing too great a risk of multiple births. Women who are being sterilised by having their tubes tied may donate unfertilised eggs. Because these women have reached the end of their own reproductive period, they are often happy to give some of their remaining eggs to be fertilised for research that aims to help other women to have normal, healthy babies.

So what research is being done or could be done on human

Ann Thompson: In Vitro Fertilisation and Embryo Transfer (Churchill Livingstone 1984)

The first two weeks after fertilisation are a period of preparation for the later development of the embryo. The primitive streak marks the place where the embryo itself finally begins to develop. In these diagrams, the outer portions of the pre-embryo are omitted from 11 days on



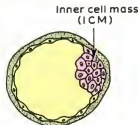
Fertilisation



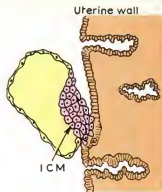
30 hours



3 days



5-day blastocyst



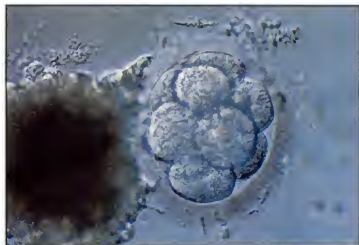
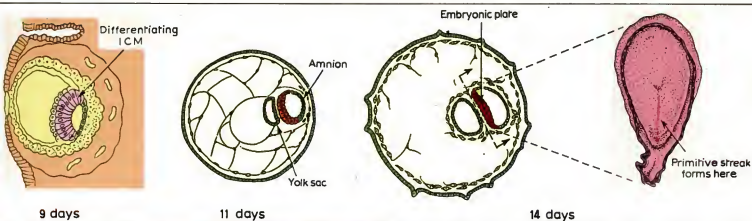
6 days

fertilisation and early development, and what benefits might it bring? The main areas of research to which IVF can usefully contribute are, in my view, the following:

- **Alleviation of infertility.** Researchers can seek to improve existing therapy, and IVF in particular. Furthermore, research may reveal the causes of other forms of infertility, and point to new methods of treatment.
- **Regulation of fertility.** Here we might hope to develop methods of contraception, aimed at sperm or egg or the pre-embryo in its early cleavage stages, that are both safe and effective.
- **Prevention of genetic and chromosomal defects.** Research

could determine whether such defects in a pre-embryo can be diagnosed before implantation. It might also help to elucidate the causes of the chromosomal defects that appear around the time of fertilisation.

These are not trivial objectives. About a quarter of a million people in England and Wales suffer from infertility. If safer, more effective, more acceptable contraceptives were available, the number of induced abortions would be nothing like the present figure of 125 000 a year. At least 1 per cent of the babies born in Britain suffer from a genetic or chromosomal defect—that is, 7000 babies a year. Many other approaches to these problems are already under way, includ-



From fertilised egg (left) to a cluster of eight cells: the technique of *in vitro* fertilisation has opened the earliest stages of human development to scientific scrutiny

ing experiments on animals. Valuable though the research on animals is, species differ greatly. Before any results can be put into clinical practice, they must be checked on human material.

The Committee on Human Fertilisation and Embryology, set up by the government and chaired by Mary Warnock, recommended in 1984 that research on *in vitro* fertilisation and early human development should continue. But the committee also recommended that a statutory licensing authority should regulate such research. It argued that all centres carrying out IVF should be registered, and only research projects approved by the authority should be carried out. As an interim measure, until the complex legislation required to implement the Warnock recommendations had been brought before parliament, the Royal College of Obstetricians and Gynaecologists and the Medical Research Council set up last year a voluntary licensing authority along the lines suggested by the Warnock committee. The authority published its first annual report this week. Half of its members are lay people, including its chairman. To date the committee has visited all 26 British centres involved with IVF: 23 offer an IVF service, of which seven also carry out research, while three do only research.

Some scientists are understandably reluctant to embark on research until legislation has been enacted. Nobody wants to put effort into a project that a private member's bill might at any moment turn into a criminal offence. Nonetheless, a number of research proposals have been submitted to the voluntary licensing authority. These proposals were well thought out, with clearly stated objectives relevant to one or more of the problems above. Their titles are listed in the authority's annual report. All projects have been approved by a local university or hospital ethical committee.

The largest group of projects seeks to improve the success of IVF as a clinical treatment for infertility. Clinicians give women undergoing IVF various hormones to cause their ovaries to "superovulate", maturing several eggs at the same time, ready for harvest by the laparoscope. Collecting half a dozen eggs or more in a single operation increases the chances of achieving fertilisation *in vitro*. Researchers are monitoring what effect varying the hormone regimes given to the women has on the maturation and fertilisation of the eggs, by studying the chromosomes of the pre-embryos and by time-lapse cinematography of cleavage stages. We know from studies in animals that eggs matured in the wrong conditions may die as embryos. We do not yet know what factors are critical for the maturation of human eggs.

Studies of the energy metabolism of pre-embryos and the pattern of proteins that they synthesise can provide biochemical measures of normal development. An understanding of the metabolic needs of human pre-embryos will allow researchers to design the best culture medium. Furthermore, if clinicians could detect metabolic abnormalities by non-invasive methods they could pick up developmental defects before pre-embryos are replaced in the uterus.

Some IVF babies—born normal and healthy—have developed from pre-embryos stored for weeks at low temperatures. Further studies now in progress aim to optimise rates of freezing and thawing and other technical aspects, so as to increase the rate of survival. Researchers are also developing appropriate techniques for freezing unfertilised eggs. They assess "normality" through studies of the chromosomes and the rate at which the pre-embryo divides after fertilisation.

Little can be done at present to alleviate infertility in men. But sperm from some "oligospermic" men (those who are infertile because they produce few sperm) can successfully fertilise eggs *in vitro*. To predict which oligospermic men should be advised to try IVF, researchers are attempting to correlate the shape and type of motility of sperm from infertile men with the sperm's success in achieving fertilisation and in supporting normal cleavage of donated eggs.

New contraceptives may also depend on research on pre-embryos. A recently developed compound known as RU486 counters the steroid hormone progesterin. Because it blocks the maturation of eggs, it offers a promising new approach to contraception. One obvious hazard would be if the drug allowed a few eggs to be fertilised, which then developed abnormally. This possibility is being examined by treating volunteer women with RU486, recovering their unfertilised eggs, and studying fertilisation and cleavage *in vitro*. Another project of potential relevance to the development of contraceptives is a study of changes in the surfaces of cells during fertilisation *in vitro*.

One approach to the diagnosis of genetic defects in a pre-embryo before it is implanted in a woman's uterus rests on the study of gene expression—that is, the transcription and translation of genes into their protein products. At present we do not even know when the new set of genes established at

fertilisation first begins to function. Researchers are tackling the question at two levels. The protein products are revealed both by two-dimensional gel electrophoresis and by the activity of particular enzymes. At the intermediate level of transcription, messenger RNAs are produced from DNA templates. These RNAs are tracked in the embryo by the procedure of *in situ* hybridisation, in which nucleic acids labelled with radioactive markers bind to like-strands of RNA in sections of the whole pre-embryo. No proposals relating to embryonic biopsy—in which a few cells would be removed from a pre-embryo for testing—have yet been submitted, although studies along these lines are in progress in other countries.

No proposals are aimed directly at the causes of anomalies in chromosome number arising around the time of fertilisation. But some studies of chromosomes in eggs subjected to various experimental treatments during maturation or fertilisation may throw light on this important problem.

None of the nine IVF centres engaged on research planned any activity classed as ethically unacceptable in the voluntary licensing authority's guidelines—such as gestation of a human embryo in the uterus of another species, growth of a pre-embryo *in vitro* for more than 14 days after fertilisation, or placement into the uterus of a pre-embryo that had been the subject of research.

When is research unethical?

The last point marks an ethical divide of critical importance. Both the private member's bill introduced by Enoch Powell last year, which fell for lack of parliamentary time, and Kenneth Hargreaves's similarly worded bill introduced this year, seek to make it a criminal offence to carry out human *in vitro* fertilisation or to possess an IVF pre-embryo, except for the purpose of placement in the uterus of a named woman. Neither bill prohibits research on pre-embryos—

Enoch Powell made this point on numerous occasions—provided the pre-embryo is subsequently transferred to a uterus. This stance echoes a Catholic viewpoint, that it is not the manipulation of a human pre-embryo that is ethically unacceptable but rather its subsequent destruction, which can be avoided by placing it into its "natural" location, the uterus.

Turn this argument upside-down and you reach the ethical viewpoint to which I adhere. In my view, if a pre-embryo or even an unfertilised egg is intended for transfer to a uterus, to develop into a wanted child, then it is entitled to all the protection that we can give it, and should *never* be used for research that might in any way prejudice its chances of giving rise to a normal baby. That entitlement is because of what it is going to be, not because of what it is. For most people, a pre-embryo is not a person or a human being or an unborn child, and we do not expend grief or ceremony over the thousands lost with the menstrual flow every month. So if a pre-embryo is not intended to be transferred to a uterus, in other words if it has no future, then it seems to me positively good that it should be used for research directed towards the sort of problem outlined above.

Of course, such research should be properly regulated and licensed. But if we are to continue using clinical methods involving *in vitro* fertilisation—and the thousand or more IVF babies born so far seem a thousand good reasons why we should—then to my mind it would be unethical not to do the research required to make these methods work better and to allow more couples to have the healthy babies that they so desperately want. □

Dr Anne McLaren FRS is head of the Medical Research Council's Mammalian Development Unit in London. She was a member of the Warnock Committee on Human Fertilisation and Embryology. (Its report was published by Basil Blackwell in 1985 as *A Question of Life*, by Mary Warnock.)

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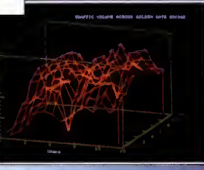
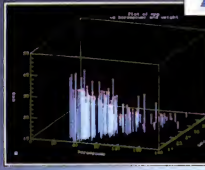
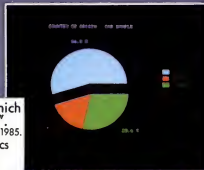
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REVIEW

Catalogue of a killer disease

MY ADVICE to anybody writing a book on AIDS is to keep adjectives to a minimum. The facts are themselves outrageous, not least to those who have watched people die with the disease. It appeared out of the blue less than eight years ago and already more than 8000 Americans, most of them young men, have died. As many as four million people around the world may be infected with the virus thought to be the cause. In many communities the number is increasing exponentially. There is neither a vaccine nor an effective treatment, and two of the main groups researching into the disease are in conflict.

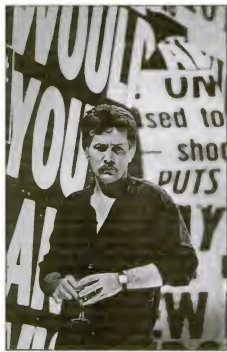
At first, particular groups were affected—most of them stigmatised minorities—but now the disease is spreading to affect all groups. Transmission is mainly through sex and blood, but children can be infected by their mothers—and more than 250 children in the United States have the disease. The media in many countries have whipped up a frenzy of misplaced hysteria while often failing to grasp the worst implications. Plague, the black death, syphilis, leprosy, and the flu pandemic of 1919 have all been invoked, but nobody knows where this epidemic of AIDS will end.

If these first paragraphs had been submitted as a possible synopsis for the seamiest of B movies just 10 years ago then they would probably have been thrown out as excessive. Now they are "fact", and a variety of journalists and commentators are trying to make sense of a story that is evolving so fast that even daily newspapers cannot keep up.

Six weeks ago I was asked to review one book, but another three have been sent to me since. And, in the meantime, in Britain alone, *The Lancet* has published a paper describing some small success in treating AIDS with an antiviral compound, the government has launched an over-fastidious public information campaign, and Larry Kramer's play, *The Normal Heart*, has opened in London. The authors of these four books were clearly up against it in trying to cover such a complicated, inflammatory, and fast developing story and two groups have, in my mind, failed. They have

AIDS and the New Puritanism
by Dennis Altman, *Pluto*, pp 228, £4.95 pbk
AIDS: the Deadly Epidemic
by Graham Hancock and Enver Carim, *Gollancz*, pp 191, £9.95 hbk, £2.95 pbk
The Plague Years: a Chronicle of AIDS
by David Black, *Pan*, pp 177, £3.50 pbk
AIDS: Questions and Answers
by V. G. Daniels, *Cambridge Medical*, pp 96, £3.95 pbk

Richard Smith



Martin Sheen against a backdrop of hysterical headlines. *AIDS on the London stage*

been brought down not by the speed of developments but by the extravagance of the tale.

Dennis Altman, one of the authors who succeeds and who spells out that he is gay, explains why the others may have failed: "In the course of writing this book", he says, "I have experienced terror and grief and anger, and they will all be reflected in these pages." Altman, nevertheless, does not let himself be overwhelmed, whereas Graham Hancock and Enver Carim have been led by similar experiences into a style that for me makes their book unreadable. They write about "wizened bags of skin and bone" and "listless cadavers slithering in a stench of incineration".

"Hundreds of thousands of time bombs," they later write, "have been, set ticking in the bodies of people throughout the world. There are not likely to be many big bangs, however. Lights will simply go out in people's

minds. Darkness will descend on many parts of their personality." And when not overdoing the adjectives or the metaphors Hancock and Carim abandon their judgment and quote Dr John Seale as saying: "There's little chance of many of our children living to a ripe old age." The two authors speculate about "an army of soldiers" suffering from mental problems induced by AIDS "quietly going crazy with lethal weapons".

Their style is also their undoing. For instance, when talking about opportunistic infections they describe them inane as "not everybody's cup of tea". Unless such writing is to your taste I wouldn't

advise anybody to bother with this book.

David Black's style is less vulgar but his book is wildly undisciplined. He has the insight, however, to recognise that "at the end of seven months of research and gorged with the horror of everything I had seen and learned I was not in a generous mood". Some of his book was written originally for *Rolling Stone* magazine and, after a while, it dawned on me that I was reading an example of "the new journalism", a genre that breaks down the divisions between novels and journalism. Thus Black describes how he got into conflict with a homosexual. After first telling the man to move his foot, Black "reared up" and roared: "You fucking faggot."

The author then devotes several pages to telling us how he first heard of homosexuals and how he first encountered one. "On Cape Cod on the high-

way between Hyannis and Provincetown," he informs us. Jokes and quotations are used liberally; dialogue is verbatim and all the "characters" are described and evaluated (Robert Gallo, the American who claimed to have been first to identify the virus, is made out to be a "baddie").

If what you want is a typical modern American novel that is at least an exuberant read try Black's book. But if you want to think further about the political and social consequences of AIDS, go for Altman.

Altman recognises that while he has made a moderate job of describing what AIDS has meant to gays in the English speaking world he has only touched on its meaning to other high risk groups and to those in other countries. Indeed, although Altman is Australian this is mostly a book about AIDS in the US. He argues that AIDS is "largely an American disease". Not only were the first cases reported there but most of the deaths have been American. Much of the research has been done there also, and most importantly, the idea of the disease as American has shaped perceptions of it around the world. The Parisian journal *Nouvel Observateur* called it "the curse which came from America".

Newspapers all over the globe have also insisted on describing AIDS as "the gay plague"; and much of Altman's book is an analysis of how AIDS has affected the way in which homosexuals see the world and themselves. His three previous books have been about homosexuality. Just like Hancock, Carim and Black, he takes the Reagan administration to task for being fast to categorise AIDS as a gay issue and slow to recognise it as a general health hazard.

Altman is strong on describing how the social and political assumptions shaped the scientific response to AIDS. The amount of money to be devoted to research, the hypotheses posed, the work done, and the groups given money were all decided in large part by political and social pressures. "Irritating as it might be to the authorities", Altman says, "the demand that the ideological biases underlying medical researchers be exposed, and that researchers be accountable to those affected by their work, is one of the positive >

► consequences of the politicisation of AIDS."

In the same way that when you read about the history of jazz you learn about the history of blacks in America, when you read Altman on AIDS you learn about the American medical system; in particular, how medical facilities are so unevenly distributed. The highest concentration of AIDS is in Palm Beach County, Florida, "one of the wealthiest counties in the United States and one, it would seem, completely oblivious to the squalor, poverty, and burgeoning health crisis in its midst".

One of Altman's main arguments is that "the disease has been laden with too much symbolic baggage", and he makes this case powerfully and intelligently. Daniels, a doctor, pays no attention to this and has produced a wholly unpretentious book that will tell you all you need to know about the disease in order to do a three-minute interview on breakfast television. But it will be out of date by the summer and another 16 books will be competing for shelf space. □

THE story of Woman the Scientist begins in the 20th century with the likes of Marie Curie. Or so you might think. Margaret Alic has all but relegated this famous scientist (and her successors) to a short epilogue. Yet she has still managed to unearth over 100 women scientists. Most of these contributed to a published work. Some were the sole authors.

Women such as Maria the Jewess, an alchemist from the 1st century AD who invented several items of laboratory equipment (the water-bath, in French, still bears her name) and wrote influential treatises on the subject. Or Hypatia of Alexandria, a mathematician and philosopher from the 4th century AD, who was much admired by her students. The early Christian Church unfortunately did not share these feelings and Hypatia was horribly murdered by a mob of zealots at the instigation of St Cyril. And Trotula of Salerno, an author of classic medical texts in medieval Italy. Later historians seem to have gone to some lengths to argue that she was, in fact, a man.

Some of these scientists became respected authorities in their day. But how could such remarkable women remain hidden from history? This vanishing trick seems to have been one of the specialities of women scientists. Alic argues that it was accomplished by,

AT THE time of the recent Voyager fly-by of Uranus, a number of science fiction writers were enjoying the VIP treatment at NASA's Jet Propulsion Laboratory in Pasadena. This was the real McCoy—science fiction coming true, right before our eyes. Such stalwarts as Ray Bradbury, Poul Anderson and Philip José Farmer listened intently as the details of the operation were explained. Captivated as I was, I did notice, in the flickering light of the TV tube, that Greg Benford's eyes were closed and he appeared to be dozing. Surprise was replaced by understanding when I remembered that, in addition to being a writer, Greg is a professor of physics at the University of California. What was novelty to the rest of us was of course daily routine to him.

When I read this collection of Asimov essays, at times I felt very much like Greg and the physics lecture. Too much was too familiar. Very early on I began to wonder just who this book was aimed at.

The first eight pieces concern themselves with physics and

Asimov again

The Subatomic Monster

by Isaac Asimov, Grafton Books, pp 213, £9.95

Harry Harrison



astronomy. Benford would certainly doze through these. I read them with some interest because Asimov is always a skilled and knowledgeable science writer. But there was nothing here that I had not picked up as an amateur astronomer and reader of *New Scientist*. It was interesting to be reminded of the state of the art—but if I wanted that I would rather read a more complete book than a few brief articles.

What about the balance of the book? Chapters 9 and 10 review what is known about oxygen and chlorophyll. Once again Benford dozes. So do I. All this I recall from secondary school,

with the notable exception of relatively recent research into the nature of chloroplasts. But this research was done in the 1950s and 1960s, so would again be more than familiar to most readers of this magazine.

Seven chapters to go. Number 11 is a letdown since it begins with the work of Marvin Minsky, of the Massachusetts Institute of Technology, and ends with some very obvious observations about artificial intelligence. AI is so exciting, so filled with discoveries and applications that could have been mentioned, that I felt only despair at the opportunity Asimov missed.

I hurried to the next chapter, on the circulation of the blood. Some odd and interesting facts here—did you know that the ancient Greeks believed the heart was cooled by a saliva-like substance called *pituia*. It is from this that we get the present

Swiss entomologist. She carried out an investigation of bees for a textbook. It was published under her (blind) husband's name!

Many distinguished scientists clearly did not feel that their wives or sisters had any use for independent reputations. Consequently, the work of these silent partners was quietly absorbed. Lack of formal training also consigned swarms of women to laborious, repetitive astronomical calculations or taxonomic work.

The rapid development of modern science meant eventually that even keen amateurs had to be left behind. A university education became an essential prerequisite of a scientific career. The book features several poignant struggles for this basic right. Opinion among male scientists ranged from active support to open misogyny (heavily weighted towards the latter). Scientific rationalism, not to mention good sense, appear to have been in short supply among some of the greatest minds of the Enlightenment when it came to the question of women.

Alic does not attempt to claim that the total contribution of women scientists rivalled men's. She does however show, very convincingly, that it was far greater than most of us suspected. Far from being repelled, or at best indifferent to science, women often had to be

Invisible scientists

Hypatia's Heritag

by Margaret Alic *The Womens Press*, pp 230, £4.95

Tania Monteiro



among other factors, their own self-effacement, compounded by the prejudices of generations of later historians.

Unobtrusiveness was often a good strategy: Agnoscice (circa 300 BC) evaded a ban, on pain of death, imposed on female doctors to set up a practice in Athens by dressing as a man. Although discouragement was usually less obvious, for reasons of propriety women regularly published under male pseudonyms or even initials.

Scores of wives, sisters and

assorted relatives of many successful scientists come over as a particularly hard done by group. At a time when women were barred from educational institutions they often assisted relatives and were in some measure self-taught. It is made very clear that many went far beyond housekeeping duties or even the mopping of perspiring brows. In fact, some of the circumstances described would nowadays drive the most timid of PhD students to mutiny.

Take the case of Lullin, a

day word "spit".

The book closes with three essays on chronology. Great periods of time are considered as years. An example is the "Fossil Year". Here vertebrates appear on 1 March and civilisation begins on 31 December at 11:50 in the morning. All very interesting of course—but to whom?

That is the problem. There is certainly nothing here that might appeal to *New Scientist* readers who have any generalised scientific background. On the other hand this book would be a wise purchase for any public or school library. Well written and clear, this collection might possibly enchant the reader with the fascination of science and induce him or her to study the subject, rather than become one more grain of grist ground out by the mill of general education.

Buy this volume and present it to a young relative in the hope that it will accomplish this happy educational goal. However, I definitely do not recommend it to anyone who has done chemistry and has long been acquainted with the meaning and importance of $E = mc^2$. □

forcibly evicted from the field.

Alic also points out that these were mostly very privileged women, often wealthy aristocrats. Lesser women remained anonymous. As such, the thread running through to the modern professional woman-in-the-laboratory is in some cases difficult to follow. One wonders what they would have made of citation indexes, the scramble for SERC (Science and Engineering Research Council) grants or star wars money while still keeping a firm grasp on the current state of nursery provision.

Hypatia's Heritage is primarily a popular book; no scientific training is required to read it. In most cases the work carried out by the scientists is not described in any great detail. Alic uses the term "scientist" in a broad sense: the people featured include science popularisers, teachers and laywomen. A smaller fraction conform to the modern concept of what constitutes a research scientist. Much of the book is taken up with biographical accounts and the backdrop to the scientific research. Some of Alic's conclusions, however, might not meet with universal approval from today's historians any more than they did in the past.

On balance, this is a very entertaining book. It is full of interesting anecdotes and should appeal to a wide spectrum of people. □

Strandlopers and flowering ferns

Earthworks

by Lyall Watson, Hodder and Stoughton, pp 186, £9.95

Roy Herbert

LYALL WATSON is, I am aware, considered by the majority to be something of an oddity, to put it mildly. So, in an effort to remain unbiased, the reader of his latest book of essays may be in danger of leaning too far backward. Anyone familiar with the works of humorist James Thurber will recognise that this is just as bad as leaning too far forward. It makes for tricky progress. The warning signs are there on the very first page—the signs showing that there is strange territory ahead.

Some people in Poland tell a story of the flower of the fern. Watson says, when ferns clearly do not have flowers. He promotes this fable to a "belief", adding that such things are worth a second look, because he suspects that many of them "reflect a longer-lasting, more natural kind of knowing". I have no idea what that means.

Caution keeps the pace slow. The first essay of the collection, whose title is the oxymoron, "The success of failure", describes the young Watson discovering the skeleton of a large-skulled prehistoric man called a Strandloper on a beach in Africa. Without any evidence, Watson concludes that these ancient men spent their time sitting, thinking and dreaming, instructing each other in manners and morals, "learning grace and loving beauty, finding satisfaction in making ideas rather than machines". He goes

on, "I think they may well have discovered trance states and perfected effortless techniques of consciousness-raising that we are now only beginning to explore". There is much use of phrases such as "I have a feeling" or "I choose to think". Well, the best of British luck, but it is hardly convincing.

On the other hand, "The roots of awareness", another essay, is entirely convincing in its way. This recapitulates the well-known claims made about the ability of plants to read minds and respond to human moods and intentions. It contains some information that I had not seen before. Watson cites the case of an American researcher, who was used to talking to his plants by telephone. The researcher attached a potentiometer and recorder to his plants while he went off for an intimate week-

end with a girlfriend, 100 kilometres away. When he got back, he found that recordings had been made of unprecedented peaks which "as far as he could remember", corresponded with every shared orgasm in the distant lakeside cottage. I like "as far as he could remember".

The man was a gent. He could have looked at his wristwatch and noted the times. Questions arise. There must have been a fair amount of "noise" from sexual activity in the area between the lakeside cottage and the plants, so they showed amazing discrimination as well as sensitivity.

But this is being too solemn by half. Watson's book, which the publicity blurb claims takes a "provocative, all-embracing view of the natural world", tells lines and all, is interesting on several levels. Still, it is apt to produce feelings similar to those experienced on meeting a man with staring eyes who will not let go of your lapels. The book is illustrated by line drawings which the publishers like. Jolly symbolic they are too. □



Listening in on love.
Potted plants have extraordinary powers

The story of human folly

Common Ground International

A new exhibition at the Natural History Museum, London*

Michael Cross

COMMON GROUND's first exhibit carries the essential message. It is a mirror bearing the words: "Look! The most dangerous form of life on Earth." This should impress some of the little horrors who are likely to see the exhibition. However, there is a chance that a more dangerous message may emerge.

Common Ground is a poster show, mounted by a group of organisations such as Friends of the Earth and Save the Children Fund, about humankind's unsociable activities. We wipe out at least one species of plant or animal each day, we destroy tropical forests so that we can stuff ourselves with hamburgers.

A privileged minority grabs most of the world's resources and we condemn 27 children each minute to death from poverty. We pollute our environment with our materialism and our bodies with narcotics and junk food.

All this is very worthy. Particularly welcome is the idea that we can do something about it, by joining organisations, planting trees and so on. But one of the ideas amid the gung-ho environmentalism deserves more subtle treatment. Too many people believe already that poor people are poor because there are too many of them. This exhibition reinforces that prejudice.

The theme of overpopulation occurs over and over again. One of the first panels describes a "tide of people" growing at a rate of a million every five days. Another equates the Ethiopian disaster with the growth in the country's population from 9.5 million to 42 million.

The problem is, most parts of Ethiopia are not overpopulated. Although the country's high birth rate (a symptom of poverty) threatens to put an unacceptable strain on Ethiopia's resources, it is simplistic to cite it as the main cause. Nevertheless, the museum deserves praise for mounting an exhibition that raises contentious issues. It could presumably have accepted money to mount a far more lavish show on the benefits that the hamburger or tobacco industry bestow on us. □

*Common Ground International, in London until 7 May then around Britain.

RICHARD Dawkins, Oxford zoologist, is undoubtedly a nice guy. He was understandably concerned when right-wingers used his book, *The Selfish Gene*, to justify their politics. He was also concerned when the extreme left attacked him. One partisan accused him of being responsible for putting Margaret Thatcher into power.

BBC2's *Nice Guys Finish First* (Horizon, 14 April) gave Dawkins the chance to answer back. He demonstrated that cooperation ensures survival and that reciprocal altruism is pre-programmed by natural selection. The latter is not obvious in humans.

Dawkins introduced us to a game—*Prisoner's Dilemma*. It was devised by a psychologist. The game offered players a choice between conflict and cooperation. The option for conflict tended to dominate even though cooperation promised a greater reward.

Such a perverse choice, in a game said to mirror real-life situations, might have encouraged those who believe that nice guys invariably finish last. Dawkins, however, drew our attention to the research of an American political scientist, Robert Axelrod. He invited game experts to submit strate-

The not-so-selfish gene

gies for succeeding at *Prisoner's Dilemma*. The strategies were in the form of computer programs. The programs were played against each other and, surprisingly, the selfish tactics came bottom. Top was a tit-for-tat strategy.

Dawkins explained the characteristics of the winning strategy: nice opening moves, swift and effective retaliation in the face of nasty rejoinders, and equally swift forgiveness.

Such a strategy, he said, had been pursued by the entrenched armies in the First World War. Until, that was, the generals, alarmed by the altruism, had put paid to it by introducing random raids. This destroyed all cooperation and created general apprehension.

Dawkins also explained how selfishness, which led to short-term gain but long-term loss, damaged the ecology.



Dennis Hackett

Some political scientists were so concerned about the dangerous dilemma individual selfishness presented to civilised society, that they thought something should be done about it. They proposed controlling some areas of human activity.

Dawkins favoured less of the rule of law and more of Kipling's law of the jungle. Kipling did not allude here to the survival of the fittest but to cooperation within species for the greater good of the whole.

As a demonstration of this kind of good living we saw chimps grooming each other, an activity which led Dawkins to speculate on this activity. Mutual grooming was rewarding.

Dawkins ruminated that there would doubtless be "cheats", who allowed themselves to be groomed but did not recip-

rocate, and "suckers", who dashed around grooming fellow-creatures like mad while becoming increasingly tick-ridden themselves. In such a state of affairs the most successful society-member would be, in Dawkins' words, the "grudger".

The grudger's characteristics would be a disinclination to groom any fellow-creature who failed to do tit-for-tat on a previous occasion.

This returned one's mind to the possibilities of tit-for-tat in our own habitats. Dawkins was optimistic about the prescription because, as in *Prisoner's Dilemma*, it maximised winning and averted the catastrophes into which unbridled opportunism might lead us.

He saw some evidence in the Reagan-Gorbachov relationship (though this programme was made in advance of the strike on Libya) that tit-for-tat strategies, where initial niceness was accompanied by reciprocal forgiveness, might be gaining in attraction. Obviously this would be the best basis for a peaceful and therefore profitable relationship, but though Dawkins did a good job of putting down misinterpreters of his book, he is barely off the mark in persuading nasties to see benefit in niceness. □

This week's reviewers

Harry Harrison is a science fiction writer.

Tania Monteiro is an astrophysicist

at the University of Newcastle.

Richard Smith is assistant editor of the *British Medical Journal*.

Materials Sciences in Space

A Contribution to the Scientific Basis of Space Processing

Editors: B. Feuerbacher, H. Hamacher, R. J. Naumann



1986. 199 figures. Approx. 500 pages

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Springer-Verlag Berlin Heidelberg New York Tokyo

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Influenza at home and at work

Observations on the epidemiology of human influenza from John Browne and William Laing

WE SHOULD like to use the pages of your journal to bring to the notice of other investigators our recent conclusions on the transmission of influenza through human populations. We believe that our findings may have applicability to many viral diseases and that they point to the possibility of analogous systems in other types of contagium.

The concepts we describe here came as flashes of inspiration during an informal discussion of the currently popular theories which propose that viruses may have arisen from the DNA of their hosts. Having once recovered from the light-headed euphoria which accompanies such moments of enlightenment, we intended at first to amass the considerable number of case histories and the epidemiological data required to establish our hypothesis objectively in a formal paper. However, we have decided that the validity of our interpretations may be readily appreciated by any astute observer, and indeed by most obtuse observers too. Furthermore, it is essential, in order to limit human suffering as far as possible, that our conclusions be disseminated expeditiously.

The first part of our hypothesis was formulated after we recalled several cases of colleagues who insisted on reporting for work despite having the flu. Often, sufferers claimed that they wanted to meet their responsibilities to various research programmes, although typically they would not be able to specify any functions which irrefutably required their attendance. In fact, it appeared to us that many patients were more conscientious than usual. People who would normally take time off for a case of sunburn or to rest a mildly sprained ankle could be found performing the most disagreeable tasks after falling victim to the flu. At the same time, they spent a good proportion of their day visiting other staff to explain their misfortune in being infected.

Intuitively, we felt that these symptoms were induced by the influenza virus itself. Indeed, it was easy to hypothesise that a portion of the viral DNA might code for peptides which mimicked the effects of some of the body's own hormones. The resulting change in hormone balance might well trigger the symptoms which we recognised—symptoms which have undoubtedly been noticed, but not diag-

nosed, by many other observers.

Tentatively, we have christened this effect the Virally Induced Keenness, Industry and Needless Ginger Syndrome, or VIKINGS. Hypothetically, the genes responsible for VIKINGS would have evolved to ensure the rapid and widespread dispersal of the flu virus by making contact with the diverse range of people that

most other scientific research establishments, with 44 men and 13 women.

The explanation of this anomaly is, of course, that many flu sufferers are overcome by quite opposite emotions. On the first intimation that infection has occurred, these sufferers, who are usually male, retire to bed. Subsequently, they demand the most solicitous attention from a wide circle of relatives and friends—particularly those of the female gender. No ploy for sympathy is beneath the dignity of these people. A hot water bottle, plumped pillows, a soothing hand on the fevered brow are all accepted with touching gratitude.

This response also is most certainly invoked by hormone changes caused by viral genes. Whereas the VIKING syndrome exposes a large number of people to a relatively low risk of infection, this alternative reaction is complementary in that fewer people are exposed to a much higher risk of infection.

We have named this second effect the Virus Associated Neurotic Desire for Attention and Love (VANDAL) syndrome. Significantly, the reactions associated with this syndrome are likely to lead to the infection of people who are themselves predisposed to displaying the VIKING response.

Although mediation of the VIKING and VANDAL syndromes is a matter for conjecture at this stage, it seems irrefutable that the genetic basis lies in the influenza virus itself. This being so, future studies of the molecular biology of the virus can be expected to disclose homologies with genes coding for the human hormones responsible for invoking the behavioural patterns we have observed. □



sufferers associate within the work environment.

We knew that this hesitant conclusion was justified as soon as we deduced the second complex of symptoms which may accompany flu infections. This came about when we noticed that it was predominantly our female associates who exhibited the syndrome. This was despite the fact that the sex ratio in our institute is similar to that in

We have ways of making you relax

Jenny Bryan on the business of managing stress

IT'S HARD to imagine Britain's captains of industry slumped in their swivel chairs, eyes closed, doing relaxation exercises. Until recently, relaxation techniques were for eccentrics and Americans, but now it's British managers who are looking at ways of reducing stress.

Employee Assistance Programmes—or EAPs, as they are known—carry the necessary air of authority. They grew up across the Atlantic in response to a trend for employees to sue their bosses over heart attacks and nervous breakdowns, which they alleged were caused by too much pressure at work.

To help to protect themselves, some companies set up counselling services and relaxation courses to show that they were indeed looking after their employees. Finding that these schemes not only saved on legal fees but actually reduced sick leave, health insurance premiums and the turnover of staff, American firms started introducing their British subsidiaries to the idea of controlling stress.

A handful of companies in Britain, including TSB, Johnson and Johnson, and Control Data, now have their own counselling services or are hiring consultants to run services for them. The rest are being

► wooded by about 50 commercial ventures offering a variety of schemes for managers which are part health farm, part holiday and part relaxation therapy.

The Positive Health Centre, based in Harley Street, has the advantage of being masterminded by an acknowledged expert on stress, Malcolm Carruthers. The centre has been helping individuals to relax and cope with the stresses of everyday living for 15 years, but it has now turned its attention to industry. Carruthers and his team are introducing companies to the idea of screening for stress and introducing relaxation techniques at a series of one-day seminars.

Reactions of people attending the first seminar seemed mixed but, according to Positive Health, four of the 15 companies that sent representatives are now negotiating courses tailor-made to the requirements of their executives.

Central to Positive Health's programme is a technique called autogenic training. Autogenic means generated from within. Clients are taught to relax through a series of mental exercises. "Imagine the space between your eyes... imagine the space between your ears..." says the friendly but firm voice of the programme's leader. The idea, says the brochure, is "to switch off the stress 'fight and flight' system of the body and switch on the rest, relaxation and recreation system".

Courses last one day a week for eight weeks. The cost, for 10 averagely harassed executives, is £1800, including preliminary screening for stress.

Middle managers are the main targets for relaxation courses and EAPs. This is because surveys have shown that the upper echelons of management are more at risk from business lunches and riotous living than from stress at work. It is their heavily mortgaged juniors, striving to meet targets and frustrated by lack of decisions from above, who are headed for heart attacks and nervous breakdowns. Yet it will be the company directors who sign the cheques for stress programmes for their middle managers. So should they be setting aside thousands of pounds for these courses?

"There's nothing clever or complex about relaxation training," says Tom Cox, director of the Stress Research Group at the University of Nottingham. "You don't need very expensive courses with lots of mumbo jumbo: if people see these up-market courses there is a danger that they will put their hard-won resources into sending people on them instead of investing it in long-term prevention."

Cary Cooper, professor of occupational psychology at the University of Manchester

Jenny Bryan is a freelance medical journalist.

Institute of Science and Technology, believes that "in-house" counselling is more effective than external courses, because it can help to bring to light



Feeling stressed? The solution could come from within

practices within an organisation which are causing stress among employees. His department has recently been awarded a grant by the Health and Safety Executive to assess just how cost-effective counselling about stress can be.

Control Data, an American computer company, has been very impressed with the benefits of counselling. Having saved several million dollars on medical care and

absenteeism in the US, the company has been running a 24-hour, seven-day-a-week counselling service for its 1600 employees in Britain since 1981. Between 400 and 500 people seek help each year, with about two-thirds of cases involving family and domestic problems, and one-third concerning issues related to work.

Rather fewer people at Johnson and Johnson have applied for counselling since the company brought in a service run by an outside consultant. About 100 people, or 6 per cent of the workforce, have sought help in the 18 months that the service has been running.

Both these schemes rely on people applying for help, and this is where many experts on stress who favour counselling part company with commercial firms which go looking for people with problems.

"There may be a few individuals who will benefit from relaxation therapy, but it's much more important to increase management understanding of job stresses, and to look more carefully at job design and fitting people to the jobs they are more suited to," says Cox.

Certainly, at Positive Health's first seminar, there were some people who felt they would be laughed out of the boardroom if they recommended a scheme based on autogenic training. Most, however, had experience of burnt-out executives and were aware that they must at least be seen to be doing something about stress at work. But they'll want to see benefits on their own balance sheets, and not just on those of the new breed of stress auditors. □

So, you want to be a genius?

Words of encouragement, from Chris Smith

THERE ARE many ways of getting on in science, but one of the best is being a genius. Chance would be a fine thing, you might say. Easier said than done, you might add. But is it really just chance? Can it be done? I want to give you hope.

Consider two geniuses: Mozart and John Stuart Mill. Both share one of the essential qualities of genius—that they started young. Mozart, for example, was penning meaningful notes at six, while Mill was writing his *History of the World* at seven. But were these two really born geniuses? After all, Mozart's father was a more than passable composer, who dominated his son's early life and who may well have led him to believe that nothing mattered in the world except music. And it is not an unreasonable assumption that James Mill's conversations with his son were also somewhat one-sided.

The Mozart and Mill households may have resembled that of the Gradgrinds, described by Dickens in *Hard Times*, with the difference that Gradgrind taught his children all he knew about every known "ology", whereas Mozart senior and Mill senior confined themselves to musicology and epistemology respectively.

Perhaps, then, geniuses are made, not born. In which case, can total, dedicated immersion in a topic lead to such a complete mastery of it that one can

advance the field (and oneself) almost routinely? Could most, many, or at least more scientists demonstrate the qualities of genius—and the rest achieve far more than they do—if only they had the single-mindedness to apply themselves to their line of research in the way Mozart applied himself to composition?

There are strawmen in the psychological wind to suggest that this may be possible.



One such straw is the suggestion from psychologists who subscribe to the information-processing approach that the essence of intelligence is less a matter of an ability to reason than of knowing a lot about the world. In their view, intelligence should be defined not so much as the degree to which we possess each of a considerable number of specific abilities, but in terms of the extent and structuring of the knowledge with which we fuel those abilities. Now, if that is the case, all scientists are potentially more equal than they may have thought, and differ primarily only in the size and organisation of their mental databases. Lack of success may reflect less a lack of inspiration than a lack of perspiration.

A second ray of hope for all comes from cognitive studies of contemporary potential Mozarts—children identified as gifted or as prodigious in their performances in such domains as mathematics, music, chess or computation. Research by developmental psychologists has demonstrated that such individuals are not in an advanced stage of development generally and perform no better on most measures of cognitive development than other children of their own age, even though in their forte they outperform most adults. If a child becomes motivated enough to focus his or her attention almost exclusively on one area then the sky (or the University of Oxford for a Ruth Lawrence) is the limit. If single-mindedness is indeed the important factor, then age should be no impediment to becoming an expert system. All one needs is the spark.

Finally, and most importantly, the methods by which children acquire and organise knowledge are those of the natural scientist. Left to their own devices (and given the resources) children are diligent researchers. They will happily and spontaneously discover theories of how the physical and mathematical world works. Their theories may not be correct, but they profit from making errors unless the errors are linked to guilt or disappointment. In his book *Mindstorms* (Basic Books, 1980), Seymour Papert describes how very young children learnt relatively complex aspects of geometry with minimal guidance from adults by using a simple computer language. Papert describes how the children used errors as a source of information and learnt from having to correct their programs. Errors were welcomed rather than loathed.

What it boils down to is this. Intelligence is nothing more than the selective application of common basic mechanisms to a wide range of information. Genius is nothing more than the selective application of intelligence. Mozart wasn't any more of a genius than anyone else: he just had a father who focused the application of his intelligence. In the same way, perhaps, most of us appear to lack genius because we fail to apply ourselves. If genius is not age-dependent, then it may not be too late to become one. Only your mind stands in the way of your brain. □

Chris Smith is a lecturer in psychology at Lancaster Polytechnic.

Bugs in the Chinese system

John Lamb on China's attempts to upgrade its universities

CHINESE universities have one of the highest ratios of staff to students in the world, in some cases as high as one staff member for every four students. But far from being happy with their good fortune, the Chinese authorities are busily trying to shed lecturers and their assistants. During the Cultural Revolution, many people were drafted willy nilly into higher education, regardless of their qualifications for the job. It was difficult to know who was qualified anyway, because at the time Chinese universities did not give degrees. Once in place, staff were under little pressure to produce results, because universities ensured that all students passed their exams.

Now, things are changing. Over the past eight years, the Chinese have been gently nudging open the door of their closed society. New political and trading links have been forged by a leadership anxious to assimilate the best from the rest of the world. Chinese universities, too, have been looking abroad for new ideas. Better teaching of science and technology has been a priority. In 1981, the World Bank lent China \$200 million to spend on scientific equipment, attracting visiting staff and underwriting the cost of visits abroad by Chinese academics.

Since 1981, more than 2400 Chinese have visited overseas universities under the World Bank scheme, and some 400 foreign consultants have trekked to China. Over 80 per cent of Chinese students who travelled abroad ended up in either the US or Canada. It is a state of affairs that worries Olek Zienkiewicz, professor of civil engineering at the University College of Swansea and one of the five foreign advisers on the Chinese project.

"What we are doing is making contact with people who will be leaders in the future," says Zienkiewicz. "The fact that only a small proportion of Chinese studying abroad come to Britain means that the influence of Britain in China will be correspondingly smaller."

The Chinese are put off by the high fees charged in Britain and the fact that they have difficulty getting permits to come to this country.

The Chinese have spent by far the largest part of the loan from the World Bank, some \$50 million, on computers for 28 universities taking part in what is called the Chinese Universities Development Project Number One. They spent half the money on minicomputers, and half on mainframe computers for 14 major universities. Most of the mainframes are Honeywell DPS machines, although they also bought a few

systems from the Japanese.

The Chinese planned to use the computers in centres that would provide instruction and computing facilities for students of science, engineering, management and social science, as well as for graduate researchers and administrators. Unfortunately, the project has suffered a number of setbacks.

First, although the Chinese signed the main contract for computers with Honeywell in 1982, the computers were finally commissioned only last summer. The delay has meant that the universities have to



Catching up: Chinese students try to get to grips with computers

some extent been overtaken by changes in technology, particularly the emergence of the microcomputer as a teaching tool.

Many of the people involved in the project are now convinced that they chose the wrong computers in the first place. Although up to 64 people can use one of the Honeywell machines simultaneously, the systems restrict the size of the programs that students and researchers can run. Many researchers have had to do their work on machines owned by industrial companies.

A second problem has been that the universities have been dogged by machine failures. Up to 60 printed-circuit boards had to be replaced in systems running at Tianjin and Qinghua universities. At other universities, the Chinese air conditioning units failed. In Shanghai, a mainframe computer was put out of action for several weeks when cable ducts in the computer room were flooded.

These equipment failures were compounded by the fact that the Chinese authorities had declined to pay for maintenance contracts that are part and parcel of Western computer operations. As a result, they could not rely on Honeywell sending engineers to fix the machines.

For all that, the computer project has given a useful fillip to the use of computers at Chinese universities. As the organisers of the project put it, "It is an old Chinese saying that difficulty usually lies in starting the wheel and once it moves, it goes faster and faster." The future could well prove them right. □

Begone with the wind

Bernard Dixon on the search for the ultimate bean

WERE HE with us now, Benjamin Franklin would be chuckling with glee over news from the US Department of Agriculture's Northern Regional Research Center in Peoria. For it is there, amid the cornfields of Illinois—in the very laboratory where penicillin was first produced on a decent scale—that scientists have embarked on another great project dedicated to human well-being and communal harmony. Their goal is to solve a problem which Franklin first laid before the Royal Academy of Brussels over 200 years ago. Responding to the Academy's proposal for a new prize rewarding practitioners of "useful" science, he enunciated the following seductive sequence of thoughts:

"It is universally well known, that in digesting our common food, there is created or produced in the Bowels of human creatures, a great quantity of Wind."

"That the permitting this Air to escape and mix with the Atmosphere, is usually offensive to the Company, from the fetid smell that accompanies it."

"That all well bred people therefore, to avoid giving such offence, forcibly restrain the Efforts of Nature to discharge that Wind."

"That so retained contrary to Nature, it not only gives frequently great present pain, but occasions future Diseases such as habitual Cholics, Ruptures, Tympanies, &c., often destructive of the Constitution, and sometimes of Life itself."

"Were it not for the odiously offensive smell accompanying such escapes, polite People would probably be under no more restraint in discharging such Wind in Company, than they are in spitting or in blowing their Noses."

"My Prize Question therefore should be: To discover some Drug, wholesome and not disagreeable, to be mixed with our common Food, or Sauces, that shall render the natural discharges of Wind from our Bodies not only inoffensive, but agreeable as Perfumes."

Alas, though noble in sentiment, the statesman-scientist's project was well beyond the best bioscience of his day. Despite sporadic probings by well-intentioned nutritionists, it has remained equally intractable ever since.

Franklin's challenge has remained unanswered because the real solution lies not in disguising bodily fœtor but in modifying the components in food responsible for producing it. And that is what the ingenuities of modern genetic engineering have made possible. Hence the initiative by the people of the US Department of Agriculture. Their immediate target is the soybean which, particularly when incorporated into processed foods, has been throwing up a number of social complaints across the US.

Although the chain of causation is not fully established, the primary source of the problem seems to be oligosaccharides such as raffinose and stachyose. The human gut cannot digest these medium-sized sugar molecules, so it passes them onwards into



Benjamin Franklin flies a different kite

the colon to be consumed voraciously by the teeming population of resident bacteria. End-products of the activities of these bacteria include both inoffensive gases (carbon dioxide, hydrogen and methane) and other volatiles which, though present in tiny quantities, are peculiarly potent when vented to the world outside.

What Walter Wolf and his colleagues in Peoria hope to achieve is to produce a "flatulent-free" variety of soybean by moving genes around between strains, thereby replacing the unfortunate sugar residues with others that are more acceptable to the human digestive machinery. They began screening large numbers of wild varieties

last summer, and now feel they are nearing the stage where it may be possible to splice genes into plants to fabricate more socially acceptable beans.

This would, as I say, be welcome news for the sage of Philadelphia were he alive today. The work in Peoria may even spawn side benefits for clinical medicine. Surgeons, for example, will be relieved to be freed from the occupational hazard of big bangs when using an electrocautery to operate on the colon. Such blasts are by no means uncommon in hospitals, because flatulent often contains a sufficient amount of methane (5 to 13 per cent) or hydrogen (4 to 74 per cent) to explode if a spark occurs at an inopportune moment in the theatre. Although these odourless gases are not the principal targets of the Department of Agriculture's mission, they are evolved in the same way and their manufacture would presumably be substantially reduced. Another likely benefit is that doctors would be spared that most baffling category of complainer—the patient who farts a good deal for no apparent reason.

But there could be demerits too. Only six years ago, writing in the *New England Journal of Medicine* (vol 302, p 1474), Michael Levitt talked of the emergence of a new scientific speciality, flatulogy, and predicted that intestinal gas could become "the rightful province of both flatulogists and scatologists". He drew attention to several reports of patients whose flatulent composition had provided diagnostic clues. Pointing out that the dog's olfactory system is 10 000 times more sensitive than ours, Levitt suggested that dogs could be trained as diagnostic aides, sniffing out information beyond the range of the most experienced human clinicians or the most sensitive gas chromatograph.

Some of those diagnostic clues will, of course, become irrelevant if the physiology generating them has been thwarted at source. Nevertheless, my guess is that most sensitive souls, echoing Franklin, will feel this an acceptable price to pay. □

Empires, star wars and privy counsel

Another round-up from Westminster

THISTLE DIARY



Tam Dalyell MP

THE end of the British university system as we know it? It sounds far-fetched, but this is precisely what could happen if the government were to support the report of the Scottish Tertiary Education Advisory Council (STEAC) concerning higher education in Scotland.

The council proposes to transfer control of the Scottish universities from the University Grants Committee (UGC) to the Scottish Office—a predatory department when it comes to empire building.

The jewel in the crown of the Scottish Education Department would be the University of Edinburgh. With the backing of the Dean of the Faculty of Science, Evelyn Ebsworth, and other professors

I ASK John Butcher, under secretary at Trade, what consideration he has given to developmental work under the Strategic Defense Initiative (SDI). Butcher refers to the recent one-day private seminar for 30-40 industrialists, chaired by Geoffrey Pattie, as minister for information technology.

I spoke against the proposal in the Scottish Grand Committee. I sent my speech to Lord Croom (Douglas Allen that is), who heads the Home Civil Service. Croom is at present reviewing the constitutional position of the UGC and its role in relation to government and the universities, and is considering the implications of adopting the STEAC's report. He is due to report in the autumn.

Were Croom to be so silly—and I am sure he is not at all silly—as to accede to the STEAC's proposal, Scotland would be waving goodbye to many non-Scottish academics. This would be a tragedy for Scottish education.

The aim was to seek the views of the industrialists on the prospects of civil developments arising from British participation in the SDI. Several areas of technology, including optical computing, were considered. "However, it is still too early to form any impression of how much civil benefit will arise from this and other advanced technologies."

I understand there is considerable scepticism from a number of British industrialists about the SDI. The more they learn, the less they seem to think there is in it for Britain.

SIR ANTHONY GRANT, a former trade minister and now MP for South West Cambridgeshire, asks George Walden, under secretary at the Department of Education and Science, if he is aware that "in Cambridge at least there are definite signs of a brain drain, which could be resolved by the expenditure of a relatively small sum of money". He asks Walden and his colleagues to fight the Treasury on this issue more vigorously than previously.

Walden replies, with the Prime Minister beside him nodding approval, that the government is devoting considerable attention to this matter. The government, he says, awaits the report of the Royal Society on the brain drain. Walden adds that his department is also listening carefully to the representations from the Save British Science Campaign, which includes many distinguished men and women.



I Am delighted to learn that the Gloucestershire Police Authority has appointed one of its superintendents, who is an amateur naturalist in his spare time, to be responsible for potential offences under the Wildlife and Countryside 1981 Act. It is less than reasonable to expect the average police officer to report all that he or she knows about the bar-tailed godwit, and possible offences against said godwit.

NICHOLAS SOAMES, Churchill's grandson and MP for Crawley, tells me he was so pleased about the item I wrote about him in this diary (20 March, p 63), that he is framing it and putting it up in his loo.

Lavatories have always played a large part in the life of the Churchill clan. Herbert Morrison, who was unloved by Winston Churchill, had occasion to call on him as Leader of the Opposition in 1946. The butler found Churchill in the toilet, and said through the door, "The Leader of the House of Commons and Lord Privy Seal to see you, Sir." Back came the response from the lavatory seat, "Tell the Lord Privy Seal that I am Sealed in the Privy and can only deal with one shit at a time!"

OUR PIECE last week on the fallibility of machines supposed to sniff out explosives turned out to be horribly topical. But we hope it reminds people that security at airports is usually a matter for humans, not machines.

Some airports and airlines are far better than others. Israel's El Al has the best reputation for security. One colleague remembers having to squeeze toothpaste out of a tube to show that it was genuine.

Another prize goes to Tokyo's Narita. A *New Scientist* journalist recently tried to carry a portable computer through the security check. The armed guard was not taking any chances. "Show me working," he insisted. Our man got through only after he had tapped in a few words, and the guard had seen them appear on the screen.

Germany's security guards are wary of travellers who insist that cameras are searched by hand rather than X-rayed. Unlike their counterparts at Heathrow Airport, they insist that travellers remove lenses and click shutters.

Our experience of security in the US, the nation that perceives itself to be most at risk from terrorism, is less reassuring. A few days after the bombing of Libya, one of our people flew out of Dallas, one of the easiest places on Earth to buy a firearm. "Is there a film in this camera?" the security guard asked. She handed it back without even trying the lens or shutter.

But at least the American guards do not turn off their X-ray machines for lunch, as the guards at Nice appear to do. Nor are the machines as clapped-out as those at Bombay, where a recent visit suggested that the guards may just as well sit watching a soap opera for all the information they received from their monitor screens.

Feedback remembers only one really effective security check. It began with questioning from a check-in clerk, and a preliminary body-search by a plain-clothed policeman. Guards ransacked every piece of luggage, carefully examined every single item. Travellers then passed through a metal detector, while hand luggage was X-rayed.

FEEDBACK

In the departure lounge, earnest-looking security guards gave each passenger an intimate body search while other guards stood by with rifles at the ready. Finally, each passenger had to identify checked luggage on the tarmac before boarding the aircraft. This was all in the midst of the first phase of the Lebanese civil war. The airport was Beirut.

TWO WEEKS after the opening of the public inquiry into the fast-breeder reactor at Dounreay, the rot has clearly set in. The reporter (the Scottish legal system's term for the man in charge), was discovered in an intimate pose with members of the UK Atomic Energy Authority. They were playing Trivial Pursuit. Does Alexander Bell, the reporter, know something that everyone else at the hearing does not?

THE DESIGN CENTRE in London is no beginner when it comes to cashing in on the 1950s revival. The Design Council is celebrating its 30th birthday with an exhibition of three decades of good design. The thrash coincides nicely with the resurgence of interest in the 1950s (and with *New Scientist's* 30th birthday, more details later). Among the people who offered to open the show was that very 1980s star, Boy George.

The Design Council turned him down in favour of John Butcher, Her Majesty's under secretary of state for industry.

"He's not so glamorous, but he's where our money comes from," the council says.

THE COUNCIL for the Protection of Rural England is one of the most worthy groups around. What little peace and quiet remains in the countryside is largely a result of the council's efforts.

The group is conducting a commendable campaign against the horrors of the Channel tunnel, which threatens to shatter the suburban idyll that is Kent. As part of the campaign, the council took David Steel, Leader of the Liberal party, on a tour of the tunnel sites. By helicopter.

ENIGMA

No 356 Counting house

by Christophe Maslanka

"MY FORTUNE," said the king to his vizier, "consists of a number of identical gold pieces. I remember their number by a set of peculiar numerical circumstances. I do not speak their number openly, as there are spies and eavesdroppers at court. Instead I shall tell you indirectly."

"My fortune cannot be divided equally among my sons without splitting gold pieces. Nor could it be so divisible, unless the number of my sons were to run into thousands. My three youngest sons live in the palace, and of the other 15 some have perished in the late wars against the heathen."

"Now the number of pieces of gold in my fortune has the following curious property: if one multiplies it by the number of my sons living, one obtains a 10-digit number in which all the digits from 0 to 9 appear, with one

exception. If any number of digits be cut off the right of this number, the remaining digits form a number which is divisible without remainder by the number of digits cut off. You have a reputation of being a calculator, and so will know the number I mean, and thus the number of gold pieces in my counting house."

The vizier bowed and reached for his pen case and parchment.

How many sons and how many gold pieces did the king possess?

A £10 book token will be awarded to the sender of the first correct solution opened on Thursday, 8 May 1986. Please send entries to Enigma No 356, *New Scientist*, Commonwealth House, 1-19 New Oxford Street, London WC1A 1NG. The Editor's decision is final. The winner of Enigma 353, "Up the polls", was David Wilkinson, of Liverpool.

Answer to Enigma 353

Up the polls

Seven (that first voting was 9,8,7,5,2).

LETTERS

Broken English

Ted Bell argues that pomposity is pointless (Forum, 27 February, p 55). If Robert Hooke, who was obviously a great scientist, could write in simple language, who are we to be pompous? The answer is less of a credit to the 17th century than Bell thinks: what spells authority for us meant something else to Hooke, and it's nothing to do with his command of English.

My favourite example of the "plain" language of the early Royal Society is the note in its minutes about John Beale's cook cooking a mackerel that Beale had left to rot (to exhibit phosphorescence...). That was the style they strived for: artless, blunt, stuffed with mundane details, and it helped to mention noble or uneducated witnesses—either sort would do. To mention who was there, who said what, what they had for tea was seen to add authority to their observations, because it was corroboration that they had actually made them.

On the other hand, they had to conceal, for the purposes of the *Philosophical Transactions*, at least, why theoretically they were doing the experiment—in case that suggested they wanted a particular outcome. It had to be done just for interest's sake. They were extremely concerned to appear disinterested, far beyond what is expected of modern scientists.

Scientists wanted to distance themselves from magicians, whose authority came from their own charisma or, at best, from how nice their theory sounded. But they also wanted to differentiate themselves from "scholars", from a competing and very successful sort of authority. To scholars, authority was given by authorities: Aristotle said so, so it is so. Quite reasonably, the schoolmen believed that you don't actually have to do every observation yourself, if someone you trust (Aristotle) has already done them. But it's also reasonable to doubt that you can say anything very new without new observations.



To contrast with them, 17th-century scientists evolved a style to show their rootedness in everyday experience, even as they were moving away from it: quoting another scientist, or anyone intellectual, was to be taken as no authority, but quoting from a mechanic might be. So, no footnotes referring to previous work; no passive voice, but instead a highly personal one; and no long words.

In this highly appealing style, an intellectual who was passionately involved in the latest theoretical debates and knew that his experiments were beyond the budget, let alone the comprehension, of almost everyone, pretended to be Everyman. That some—like Newton—clearly made up the corroborative details, collapsing experiments done over months into one discrete experience, should warn us that simple language can also conceal the truth. Abstract nouns were really more how Newton thought.

"They have a... natural way of speaking... preferring the language of Artizans, Countrymen, and Merchants," wrote Bishop Sprat. We do all know, don't we, that Sprat's "history" of the Royal Society was propaganda.

I was lucky as English was obviously my better subject, but others are not as lucky and are persuaded by the so-called advantages of limiting one's options.

politicians, they played the democratic card only when they were down.

I'm not defending modern scientific papers, but I think I'd be even more put off by endless descriptions of rotting mackerel.

Ruth Wallgrove
London N16

Ted Bell laments the lack of response to the Royal Society's plea for better coverage of science in the mass media. If the one example of the society's output which I own is typical, then I don't wonder that journalists haven't responded, why should they bother to try untangling the verbiage?

I took *New Scientist's* tip and obtained a free copy of *Science is for Everybody*, which was said to be a simplified version of the society's report, *The Public Understanding of Science*. What a letdown. Such a deadweight of stodgy "wordiness". One sentence in particular stands out. I won't quote it, it's 109 words long and studded with no less than eight parentheses.

This kind of verbiage shouldn't be inflicted on anyone. In a plea for a wider dissemination of science it's ridiculous.

Colin Wagstaff
Woodlesford
Leeds

A-levels

I was interested to read your article "What's in an A-level?" (Forum, 20 March, p 62). I am presently studying for A-levels in physics, mathematics, and English, yet this was only possible by my determination not to be persuaded to do chemistry as a third subject. I feel that many secondary school teachers believe certain subjects should be studied together and any variations are regarded as foolish and not be taken seriously.

I was lucky as English was obviously my better subject, but others are not as lucky and are persuaded by the so-called advantages of limiting one's options.

I would like to make the final point that English does, in fact, fit in very well with both mathematics and physics, and it keeps the horizons broad. Before taking these options I wrote to many universities to see if these subjects would be acceptable for entry onto an electronic engineering degree course. Most of the universities seemed delighted by my choice!

Jeannette Clay
Springfield
Chelmsford
Essex

Lake Victoria

The FAO has consistently expressed disapproval of the introduction of the Nile perch into Lake Victoria and shares the widely expressed concern over the possible deterioration of the fisheries of the lake (This Week, 6 March, p 24). It advocates a policy of extreme caution with respect to the introduction of new species anywhere.

The statement that the FAO hopes to relieve the situation in Lake Victoria by the addition of more cichlids is not true. Indeed, we fear that the decline in the indigenous cichlid populations in the lake cannot be halted either by stocking with existing species or the introduction of new ones. It is worthy of note that the only other species to show an increase in population in Lake Victoria catches contemporaneously with *Lates* is another introduction, *Oreochromis niloticus*.

The FAO did not become involved with Lake Victoria until 1966/68, when it undertook a project to investigate a group of small cichlid fishes which form the basis of a fishery. Thus, while it is true that fisheries scientists did warn against the proposals to introduce Nile perch into the lake, this was done by personnel of the East African Freshwater Fisheries Research Organization in 1959, before the FAO had any involvement with Lake Victoria and its fisheries.

The quotation of FAO estimates

GRIMBLEDON DOWN

"THEN RIGGS OF PARANORMAL SAID IF WE'RE AT A DEAD END LET'S GIVE THE OCCULT A WHIRL, SO I ASKED 2 OF THE CLEANING LADIES—"



"YES, MRS HENSON AND MRS MOONEY ARE BOTH WHITE WITCHES. I'D LIKE YOUR AUTHORITY TO GO OUT ON GRIMBLEDON COMMON TONIGHT AND RITUALY SLAUGHTER SOME CHICKENS, GOATS AND—"



"WGMORE, I'M SURE THIS IS A GENUINE EXPERIMENT BUT IT'S MUCH TOO RISKY OUTSIDE. WHY CAN'T IT BE DONE HERE?"

"F YOU THINK WE'RE CLEANING UP THAT MESS..."



Bill Tidy

that overall production was down by 80 per cent in 1984 is also incorrect. It appears to be a misinterpretation of a statement appearing in a recent FAO report to the effect that one possible scenario in the future evolution of the fisheries of the lake would be to reduce catches by about this amount. Undoubtedly, a substantial reduction in present catch rates will occur eventually, but by the end of 1984 total catches from the Kenyan and Tanzanian waters of the lake had shown no reduction.

Finally, the remark attributed to me as to the percentage of the world's fishing business which is based on introduced species is incorrectly interpreted. My point was that rational introduction of new species into selected waters of the world has been and will continue to be an important management tool leading to improved yields from fish farms and small dams. In support of this argument I quoted, among others, the history of aquaculture in the Western hemisphere, which has grown in Europe based largely upon rainbow trout from the western US and in Latin America based upon African tilapia.

R. L. Welcomme

FAO

Rome

Italy

The article concerning Nile fishery exports states: "Sea Containers, a conglomerate based in Britain, has just signed a contract with Kenya's fisheries department to catch and freeze perch for Europe."

We are a Bermuda registered, marine container leasing company, whose operating headquarters are based in London and have not signed a contract with Kenya's fisheries department to catch and freeze perch for Europe. We are however having discussions with them concerning our mainstream container leasing business activity and do not wish to mislead anyone into thinking that this story has come from us.

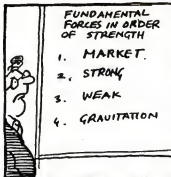
Chris Holt
Sea Containers
London SE1

Big bang

Your editorial "Teaching lessens", 3 April, p 14, which blames the "big bang" in the City of London for the recent decline in applications for university science places, misses the point. The statistics which you report do not reflect any underlying shift of student preferences. For many years now, final-year science students have opted for careers in the financial sector.

What has happened is that increasing international competition has forced firms in the City to recruit graduates with relevant academic skills (something which the scientific community does, and should, take for granted). An illustration of this is the large number of chairs of accounting recently funded by the accounting profession.

This shift in academic training must be applauded, not only will it



make the City more competitive, but it will substantially reduce the previous water in the university sector, since the cost of training a science graduate is close to twice that in social science.

This letter does not deal with the question of what constitutes the appropriate mix between science and social science skills in the British economy. The evidence on both sides would be voluminous. That is why it seems efficient for the market mechanism to make this allocation.

Len Sterratt

Department of Economics
University of Durham

Breeding chimpanzees

The problems of breeding chimpanzees and other apes in Britain ("Chimps in the laboratory: an endangered species", 27 March, p 37) were recognised in the mid-1970s. The Amphipod Ape Advisory Panel (AAPA) was formed by a number of zoos in Britain and studbooks are now produced annually, with overall breeding coordinated between zoos, through exchange of animals, in order to manage the chimpanzee population on a sound genetic basis. This effort is backed up, through development of pregnancy tests, clinical and veterinary care procedures, by the Institute of Zoology of the Zoological Society of London.

The latest chimpanzee studbook, produced by M. Badham of Twycross Zoo, lists 167 chimpanzees in 24 collections. Sixty one of these are captive born and many are growing up in large social groups, such as those at Chester and Edinburgh Zoos. There are at least 17 proven breeding males and over 30 proven breeding females.

Since 1979, 43 chimpanzees have been born in AAPA member collections, 12 of these have died and four have been exported. The majority of these captive-born chimpanzees are therefore still quite young, but growing up in genetically diverse, socially balanced groups that should yield competent breeding animals for future generations. To achieve this balance, 32 individuals have been transferred between collections during the past three years. In almost all of these cases, the transfer is on breeding loan or exchange and money is not involved.

Your article did not attribute its sources of information but much of it came from the US, where a

system such as our AAPA is not yet operating. While the situation in Britain cannot induce complacency, it is far more optimistic than suggested in your article. We are greatly encouraged by the demonstrable commitment of zoos to collaborate in an overall breeding programme for chimpanzees (and for many other species).

I am quoted in the article as a result of some critical and correct comments that I made four months ago in a general discussion on primate breeding. My comments are certainly not applicable specifically to chimpanzees or to zoos. In addition, it is not true that nothing



has been done to improve primate breeding since the publication of a survey by the Medical Research Council in 1979. There are a number of healthy, self-sustaining breeding colonies of primates in

Britain, reducing the need for import from the wild. Finally, no one would suggest that chimpanzees should be used as a front line of investigation for human disease, but only as a last resort when no other animal analogue proves suitable for such study.

John Hearn
Institute of Zoology
London

Interferons

There is a basic error in the letter "Interferon concern" (10 April, p 76). There are at least 35 subtypes of human interferons but they do not provide a four-day blanket defence.

Unlike antibiotics they have no direct action on invading microorganisms but they do act on the cells of the body themselves. Consequently, the invaders do not recognise interferons as "enemies" and in thousands of years have not learnt to become "resistant".

One of the ways interferons act is to mobilise the cellular defence mechanisms. If these are basically inadequate then the infection will still win but that is another story.

R. Marth
Higham
Kent

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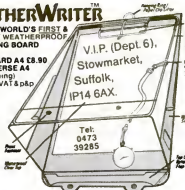
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Biochemist

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Neuroscience Research Centre

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The Animal Health Research Centre at Walton Oaks is part of the Research Division of Beecham Pharmaceuticals, one of the world's foremost research and manufacturing Companies.

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In addition the successful applicant will be required to supervise a small team which also has responsibility for the isolation of metabolites from micro-organisms.

Conditions of employment are attractive and include flexible working hours, a non-contributory pension and life assurance scheme. The laboratories are sited in rural Surrey and assistance may be given with relocation where appropriate.

To apply, please telephone for an application form to the Site Personnel Officer, Beecham Pharmaceuticals Research Division, Walton Oaks, Dorking Road, Tadworth, Surrey. Telephone Tadworth 4444, Ext 250.

Closing date: 9 May, 1986.

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Pharmaceuticals

The highly developed
skills of traditional
craftsmanship and the
latest techniques
of specialist professionals.



Process Development Manager

Pharmaceuticals

Circa £18,000

This rare and outstanding opportunity to accelerate career progression into a key management role will appeal to ambitious pharmacists with post-graduate qualifications. The position is within the UK based international development laboratories of a worldwide market leader in ethical pharmaceutical products.

Responsibility through a staff of 15 will be to the Development Director for the scale up of new formulations into production, for the provision of process improvement technical support to manufacturing plants worldwide and for the manufacture and packaging of clinical trial supplies. The purpose built laboratory and pilot plant facilities are exceptionally well equipped to optimise process development of existing and next generation products.

Applicants should have at least 5 years experience in both laboratory and manufacturing positions. A clear thinking and innovative mind must be supported by the ability to communicate precisely on a worldwide basis at all levels.

First class career development prospects are highlighted by the fact that this opportunity arises out of internal promotion. The excellent negotiable salary indicated is backed by a non-contributory pension scheme, BUPA and a full relocation package where applicable.

Male and female candidates should send a detailed CV or request an application form on 0625 533364 (24 hours) quoting reference 895/NS.

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Executive Selection/Management Development

Springfield House, Water Lane, Wilmslow, Cheshire SK9 5QS. Tel: (0625) 532446.



Southampton
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UNIVERSITY

LECTURER IN CRYOGENICS

Applications are invited for the post of Lecturer in the Institute of Cryogenics. Candidates should have graduated in science or engineering and have a research degree in cryogenics, refrigeration or low temperature physics, preferably with some industrial experience.

Salary within the scale £8020-£15 700 per annum, according to qualifications and experience.

Further particulars may be obtained from:

Mr D. A. S. Copland
Staffing Department
The University
Southampton SO9 5NH

to whom applications (six copies from UK applicants) should be sent as soon as possible, quoting reference number 2265.

RESEARCH HISTOLOGY TECHNICIAN (T4)

sought to assist in exciting new project in area of molecular neurobiology. Work will involve light and electron microscopical studies of adult and developing brain using labelled cDNA probes. Experience in histological, autoradiographic and immunohistochemical techniques desirable. Post is grant-supported and available for up to three years to the first instance. Applications and names of referees to Dr A. R. Lieberman or Dr J. G. Parnavelas, Department of Anatomy, University College London, Gower Street, London WC1E 6BT.

JOINING FORCES

We are world leaders in the design, development and manufacture of electro-optic cells and components for a range of advanced laser systems for many of the world's major industrial and research organisations.

A subsidiary of Crosfield Electronics Ltd., we are committed to the blending of highly developed skills of traditional craftsmanship with the application of advanced techniques in the pursuit of perfection in electro-optics.

The demand for optical components in a wide spectrum of precision applications is creating expansion here at our Basildon Headquarters. As a result we are looking for the following people to join our team:-

Optical Engineer

Working as a member of a small team you'll be developing and testing prototype hardware. You'll also be responsible for drawings and specifications for manufacture within budget constraints. Such projects will include competence in either: thin film coatings, acousto-optics related to lasers, ultra-sonic transducer bonding, and lens and prism manufacturing and testing technologies. We'll expect you to have at least 2 years' experience of R&D engineering of optical components and assemblies. An M.Sc in Optics or Applied Optics or alternatively BSc Physics with substantial relevant experience is essential.

Electronics Engineer

To provide the technical expertise for the design and development of new and existing products. You'll be involved with broadband linear circuits up to 1000 MHz, high voltage linear amplifiers exceeding 1 MHz, nano second switching, semiconductor laser diodes and fast optical detectors. Working as member of a small team, we'll expect you to be able to take charge of specific projects from initial marketing liaison to the specification of manufacturing processes. You should have a degree in Electronics or Electrical Engineering to complement at least 2 years' relevant experience.

In return we offer excellent salaries, in line with your skills and experience plus the full range of company benefits. And, in terms of your future, our planned growth, and increasing commitment to product development ensures significant opportunities for personal and career development for ambitious professionals.

In the first instance please telephone for an application form or write with full cv to Alison Eastham, Crosfield Electronics Ltd, Three Cherry Trees Lane, Hemel Hempstead, Herts. Tel: Hemel Hempstead (0442) 218311.



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1886-1986

Section Leader

Quality Control Division

Upjohn Limited is the UK subsidiary of The Upjohn Company, a major international research-based Company, developing and supplying ethical pharmaceutical and animal health products worldwide.

We have a vacancy in the Quality Control Division for a Section Leader who will be responsible for routine microbiological testing of products and raw materials, evaluation of new preservative systems, development of testing methods for new product formulations and some routine chemical analysis.

Applicants should possess either an honours degree in Biochemistry, joint honours in Biology/Chemistry, Ml Biol or possess an FIMLS, along with a minimum of five years experience in the Pharmaceutical or allied industry. A post-graduate qualification would be advantageous.

The Company offers an excellent salary and benefits package (including relocation expenses where appropriate, contributory pension scheme and free life assurance), career development and a pleasant working environment in an attractive part of the country.

To apply for this position, please write with details of your qualifications and experience to Pamela Gelder, Personnel Co-ordinator, Upjohn Limited, Fleming Way, Crawley, West Sussex RH10 2NJ.

Upjohn

ASSISTANT ANALYTICAL CHEMIST

Wiggins Teape, a subsidiary of BAT Industries is the third largest paper company in Britain and a world leader in speciality papers. Butler's Court, the Group's Research and Development Centre based in Beaconsfield is the largest of its kind in Europe, employing 200 staff.

We currently have a vacancy for an ASSISTANT ANALYTICAL CHEMIST to work as a member of our Analytical Section, which provides a service to the Production, Marketing, Sales and Research and Development activities of the whole Wiggins Teape Group, both in the U.K. and Overseas.

Candidates should be of graduate level, with a minimum of two years relevant experience, particularly in G.C., I.R. and H.P.L.C. techniques. The position would suit someone who finds problem solving a challenge and has the ability to work on their own initiative.

Benefits include an annual salary of £8,500, flex time and luncheon vouchers.

Please telephone or write to Miss D. Haynes, Senior Personnel Officer, for an application form.

Wiggins Teape Research and Development Ltd.,

Butler's Court, Beaconsfield, Bucks HP9 1RT.
Telephone: (04946) 5652 Ext. 296.

WIGGINS TEAPE

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TEAM LEADER

Anti-Viral Biochemistry

This is an attractive opportunity for a young post-doctoral Biochemist to join one of the world's foremost and highly respected pharmaceutical companies.

We would want you to lead a small team of Biochemists in identifying new opportunities for anti-viral research including the therapy of AIDS. You would be responsible for detailed structural and functional studies on target compounds and work closely with medicinal Chemists, using data from kinetic and inhibition studies, in the design of new anti-viral drugs.

To do this effectively we would expect you to have had up to five years wide-ranging post-doctoral experience in protein and nucleic acid biochemistry and to be fully familiar with 'state of the art' methodology. You should have leadership potential and the communication skills required to work effectively in a multi-disciplinary project environment.

We are offering good opportunities for personal and career advancement with starting remuneration in the range £11 000-£15 000 depending upon extent of previous experience. We provide generous assistance in relocating to an attractive semi-rural area of coastal Kent and other excellent benefits include five weeks holiday, pension and life assurance scheme and an active Sports and Social Club with first class amenities.

If this advertisement attracts your interest, please write in confidence quoting Ref. NSAV, giving full details of career to date to: D. O'Callaghan, Pfizer Central Research, Ramsgate Road, Sandwich, Kent CT13 9NJ.

Pfizer

PRINCIPAL PHARMACIST/ CHEMIST

London
Up to £19 685

The Medicines Inspectorate has the task of ensuring that every medicine used in the UK is safely produced in accordance with the principles of good pharmaceutical manufacturing practice.

As a Principal Biologicals Inspector you will carry out inspections of manufacturers both in the UK and overseas. You will advise the Licensing Authority on developments in biological products, the suitability of manufacturing processes and on controls for manufacture. The work is intellectually and professionally satisfying.

For further information about the work telephone Mr S. H. Hartley on 01-720 2188 extension 3079.

You should have a degree in pharmacy, chemistry or biological sciences, or an equivalent qualification, and several years' experience in the manufacture and/or control of biologically or microbiologically produced products.

Starting salary (including £1385 lower London Weighting) £16 515 - £19 685 according to qualifications and experience. Promotion prospects.

RELOCATION ASSISTANCE MAY BE AVAILABLE

For an application form to be returned by 9 May 1986 write to Civil Service Commission, Alston Link, Beaconsfield, Bucks RG21 1JH, or telephone Beaconsfield (0298) 488551 (evening service operates outside office hours). Please quote Ref: T/6834.

Department of Health and Social Security
The Civil Service is an equal opportunity employer

Career Opportunities in Clinical Trials

Attractive Package + Car

SANOPI, the UK subsidiary of a major international pharmaceutical company trading in this country as LABAZ, seeks two science graduates to join its medical department and assist with an expanding clinical research programme.

Responsibilities will include the monitoring of clinical trials on marketed and research products in the UK and Eire, primarily in the cardiovascular and neurological fields. Frequent visiting of clinical investigators is an important element of this work resulting in extensive travel throughout the UK, for which a company car will be provided. In addition you will assist senior research staff with other aspects of clinical trial work.

These are first class career opportunities for graduates with a good honours degree in life sciences and well-developed oral and written skills. Previous experience within the pharmaceutical industry, although not essential, would be advantageous.

An attractive salary is offered and other benefits include 25 days' holiday, subsidised restaurant, BUPA, contributory pension scheme and free life assurance.

Please write, enclosing full personal and career details, to Miss L White, Personnel Officer, SANOPI UK Ltd., Floats Road, Wythenshawe, Manchester M23 9NF.

sanofi



Head of Statistics Services

An opportunity has arisen for a Statistician/Biometrician to head up this important service unit. The unit is based at Brockham Park, near Dorking, but has involvement throughout the Research Division, which operates on six sites in the UK and four sites in Continental Europe.

The work carried out is extremely varied, involving contact with groups carrying out research and initial development into specific disease areas. This requires regular close contact with scientific staff.

The successful applicant should have a good honours degree and preferably a further degree in statistics or biometrics along with several years' experience in a biomedical environment. You should also be a good communicator and have a proven ability to lead a team.

The Company will offer a competitive starting salary along with other fringe benefits associated with a major international organisation. These benefits include a non-contributory pension scheme and free life assurance.

If you think you meet our requirements and would like to apply, please write, enclosing a c.v. to:-

The Personnel Manager, Beecham Pharmaceuticals Research Division, Brockham Park, Surrey RH3 7AJ.

Beecham
Pharmaceuticals



GRADUATES IN PHYSICAL CHEMISTRY

OPPORTUNITIES IN RESEARCH & DEVELOPMENT WITH ECC INTERNATIONAL LTD.

We are the major operating Company of the English China Clays Group and are seeking outstanding young scientists to join our Central Research Laboratories in St. Austell, Cornwall. The Laboratories presently have a staff of over 200 people and provide the fundamental research effort and support for the international operations of the Company.

ECC International Ltd. is a major supplier of mineral based pigments for the paper, polymer, paint and ceramic industries and has subsidiaries in many European Countries and in the United States, Japan, Australia and Brazil.

The varied activities of the Company require highly motivated scientists who can rapidly develop expertise in areas such as:-

- Fine particle mineral separation
- Paper science
- Surface chemistry of minerals and
- Polymer Science,

and provide the innovation for the future of the Company.

Candidates should have at least a first or upper second class honours degree and preferably should be about to complete a second degree.

There are good opportunities for career development in a Company which promotes on merit and almost exclusively from within the organisation. Attractive salaries and benefits are offered including five weeks annual holiday.

Applications in writing quoting Reference 359 to:-

**The Personnel Director,
John Keay House,
St. Austell, Cornwall.**

COPENHAGEN/AMSTERDAM APPOINTMENT

The Editors of the International scientific journal
NUCLEAR PHYSICS
require for their editorial office an

ASSISTANT TO THE EDITORS

The applicant should be single, preferably around 25 years old and have English as mother tongue. He (or she) should be in the possession of an honours degree in physics or mathematics (there is no demand for a higher degree). A knowledge of nuclear physics would be an advantage.

Duties essentially involve the preparation of manuscripts for the printer, proof reading and making up of issues for the journal.

Initial training will take place in Copenhagen, after which the position will be taken up permanently in Amsterdam.

There will be a trial period of three months and the applicant should be willing to stay for at least two years.

Initial salary about £8500 pa. starting June 1986.

Applications (including tel. no.) should be sent to:

**W. Hass, c/o Niels Bohr Institute,
Blegdamsvej 17, 2100 Copenhagen O,
Denmark—Tel. (1) 389718.**



RIVERS DIVISION

Technical Officer

Technical Services - Appraisal Sector

**Salary £11 067 to £12 375 pa + £702 London
Weighting. Ref: TS/A/8.**

This post is based initially at Waltham Cross and will assist the Lee Appraisal Officer in preparing a 3-dimensional holistic review of river system management within the Lee catchment. Scheme appraisal will be placed in the full environmental context of the water cycle, dependent ecology/land use and social/political needs.

In addition to considerable experience, preferably involving feasibility aspects of river engineering, you will have broad awareness of environmental issues. You will also be energetic, resourceful and motivated by concepts, including achieving objectives on time using modern management methods and new technology.

The need for effective multi-disciplinary liaison within the Authority and with external organisations, and for good relationships to be forged with them and the general public, calls for well developed social skills.

The job also requires preparation of draft specifications, work programmes, reports and presentational material. A knowledge of computer applications is desirable, but a lively and enquiring mind is essential.

A current driving licence is required as the post carries an essential user allowance. Benefits include a minimum of 22 days holiday, 35 hour week with flexitime, subsidised staff restaurant and social club.

Assistance with relocation expenses will be given in appropriate cases.

Assistant Biologist

Salary range £9999 to £11 067 pa.

**Required in the Biology Laboratory in Nugent
House, Reading. Ref 57.**

You must possess a degree or equivalent in a biological subject with a significant ecological content. You should have a full driving licence, be physically fit and able to swim. Familiarity with basic computer skills would be an advantage.

You will assist the area biologist with: Biological monitoring of watercourses requiring sampling and identification of benthic invertebrates. Fish health assessments. Algal identification and bacteriological analysis. Other biological investigations of a routine and non routine nature.

The post carries an essential car and telephone user allowance.

Hydraulic Modellers (2)

**Salary range: £11 067 to £12 375 pa. (Ref: HQ42)
£9999 to £11 067 pa. (Ref: HQ42E)**

Both posts are based initially at Reading, and will assist the Computational Hydraulics Engineer in implementing a programme of mathematical river modeling using a highly-developed quasi 2-dimensional model.

You will preferably hold a postgraduate qualification as a basis for a comprehensive understanding of computational hydraulic theory and practice and/or be able to show considerable experience in river engineering practice using computational methods. Chartered status and Membership of the Institution of Water Engineers and Scientists would be an advantage, and for the senior post applicants should be able to show knowledge of advanced Fortran programming as applied to Pressmann methods.

Benefits for both positions include a minimum of 22 days holiday, a 35-hour week with flexitime, subsidised staff restaurant and social club.

Assistance with relocation expenses will be given in appropriate cases.

For an application form please write to: The Personnel Officer, Rivers Division, Room 501, Nugent House, Varsity Road, Reading RG1 8DB or ring Reading 595457 quoting the appropriate reference.

Closing date: 9 May, 1986.



RUNNING WATER FOR YOU

QUALITY Opportunities For Scientists

The Air Weapons Division at Hatfield is the British Aerospace centre for the design and development of Air-Launched Guided Missile Systems. Our activities also embrace Infra-Red Equipment and Mechanical Equipment. Our commitment to Quality in all these areas has led to the following vacancies:

Quality Manager -Microelectronics

We require a Manager to join an established team engaged in the application of 'thick film' and 'surface mount' technologies on ceramic substrates to produce micro electronic packages.

In this field there is a growing use of innovative process control, inspection and test techniques to complement increasingly automated manufacture.

This senior position carries the responsibility for BS9450 Capability Approvals including a significant extension during the exciting transition from research to production.

Because of the particular demands of this position we are seeking candidates with a scientific background and the management skills to co-ordinate these activities.

We, therefore, invite applications from Honours Graduates with experience in this field who can demonstrate problem

solving skills and the ability to communicate at all levels.

Metallurgist/ Materials Scientist

We're looking for a person to join a small team in our Materials Laboratory which provides support to design, development and production of electronic and mechanical equipment. The successful applicant will be able to take part in a wide range of Materials Laboratory activities. Specifically, this will include the opportunity to be involved in surface studies using Auger, XPS and SIMS in conjunction with a Scanning Electron Microscope and so, experience in this field would be an advantage.

Applicants should have a degree or equivalent in Metallurgy, Materials Science or Physics together with appropriate post graduate experience, either in industry or an appropriate research establishment.

Attractive salaries will be commensurate with knowledge and experience. For further details and an application form telephone or write FREEPOST to: David Randall, Personnel Officer, British Aerospace PLC, Air Weapons Division, Hatfield, Herts, AL10 9BR. Telephone: Hatfield 77367.



RESEARCH TECHNICIAN

required to join group working on the molecular biology and expression of human muscle specific genes. The successful candidate will be involved in the characterisation of cDNA and genomic recombinants, and in the investigation of gene expression during muscle development. Experience in recombinant DNA work, while not essential, would be an advantage. Graduates and individuals with equivalent qualifications and suitable laboratory experience should apply to Dr D. A. Hopkinson, Director MRC Human Biochemical Genetics Unit, The Galton Laboratory, University College London, Wolfson House, 4 Stephenson Way, London NW1 2HE, enclosing cv and names of two academic referees.

Salary (RO scale) £6788-£8891 plus £1084 LW. Starting date July, 1986.

Faculty of Science

CHAIR OF CHEMISTRY

Applications are invited for the Chair of Chemistry at the Open University prior to the retirement of the present holder Professor L. J. Haynes.

Candidates should have a strong research record in any of the branches of chemistry. The successful candidate will play a leading role in developing the Department's teaching and research programmes and will take up the appointment at the earliest date convenient to him or her.

Salary will be within the normal UGC-approved Professional range plus USS benefits.

Further particulars may be obtained from the Secretary (84/3) The Open University, Walton Hall, Milton Keynes MK7 6AA, or telephone Milton Keynes (0908) 653710: there is a 24 hour answering service on 653688.

Closing date for applications: 20 May 1986.

ST GEORGE'S HOSPITAL MEDICAL SCHOOL (University of London) (Experimental Pathology) POSTGRADUATE RESEARCH ASSISTANT

required to join research group investigating cellular and hormonal interactions in the regulation of bone resorption. The individual should have experience in biochemical, cell culture and immunocytochemical techniques. The post is funded for three years by the Wellcome Trust. Registration for a higher degree (MPhil/PhD) should be possible for an appropriately-qualified individual.

Salary up to £7892 (inclusive of London Allowance) depending on experience and qualifications. Send full cv with the names and addresses of two referees to the Personnel Officer, St George's Hospital Medical School, Cranmer Terrace, London SW17 0RE. Closing date 22 May, 1986. Quote ref 36/86.

The Central Blood Laboratory Authority has a vacancy at the Blood Products Laboratory for a TECHNICIAN

A vacancy exists for a Technician in the Sterile Filling Department. The person appointed will report to the Sterile Filling Manager. The post holder will be responsible for the day to day running of the Sterile Filling Unit and for the maintenance of the Filling Programme. The products filled are human albumin solution and various immunoglobulin preparations. The position is chiefly a supervisory one. The filling is carried out by a team of production workers, and although not routinely involved the Technician will have to take over from time to time. The post holder will have to prepare and check batch documents and must be aware of the need for good manufacturing practices as applied to sterile filling. Training will be given but previous experience would be an advantage.

The minimum educational qualifications required are HTEC/HNC or Degree in a Biological Science. Starting salary depending on exp. qualifications and experience will be in the range £1657 to £2626 (p.a. inclusive).

For a job description and application form please telephone Mrs M. Grinter on 01-930 6191. Ref. 237 or write to the Personnel Officer, Blood Products Laboratory, Degeer Lane, Enfield, Herts WD8 3BL, quoting ref no. Prod/723/8P.

UNIVERSITY OF OXFORD Department of Pharmacology POSTDOCTORAL RESEARCH ASSISTANT

urgently required to begin work as soon as possible on a project supported by the MRC to study calcium currents and other currents associated with contraction in individual heart cells isolated from mammalian cardiac muscle. Experience with micro-electrode techniques would be an advantage. The Project is funded until September, 1988. Salary will be on the Research Assistant IA scale. Replies with names of two referees to Dr D. A. Terrar, Department of Pharmacology, South Parks Road, Oxford OX1 3PX.

UWIST University of Wales Institute of Science and Technology Department of Applied Biology TECHNICIAN (GRADE 5) (Re-advertisement)

to operate and maintain chemical analytical equipment (principally AAS and GLC) for research and purchasing consumables. Minimum HNC/D plus minimum of five years laboratory experience.

Salary on Scale £6927-£8088 pa.

Previous applicants need not re-apply.

Applications in writing with cv and names of two referees, quoting Ref AN78 to the Staffing Office, UWIST, PO Box 68, Cardiff CF1 3XA (returnable by 12 May, 1986).

Development Pharmacist

Rural Herts

£7,645 - £9,850

We are responsible for the manufacture of Glaxo Pharmaceuticals and their sale in this country. Our site at Ware, which employs around 1100 staff, is situated in an attractive setting on the River Lea.

We have an immediate opening for a Development Pharmacist in our Aerosol Manufacturing Unit, who will be directly responsible for a number of key projects. These will include the introduction, modification and validation of new and existing equipment and manufacturing processes and procedures.

Applicants should be recently qualified pharmacists or life science graduates.

In addition to an attractive salary, the Company's generous conditions of employment include profitability bonuses, non-contributory pension scheme and excellent sports and social club facilities.

Please write or telephone for an application form to: Steve Brain, Personnel Department,

Glaxo Operations UK LIMITED

PRIORY STREET, WARE, HERTS SG12 0DJ. TEL: WARE (0920) 3993 EXT. 2176.

THE UNIVERSITY OF LEEDS Department of Organic Chemistry

LECTURER

Applications are invited from suitably qualified candidates for the above post commencing 1 October, 1986 or as soon as possible thereafter for a fixed period of one year.

Salary on the Academic Scale for Lecturers (£8020-£15 700) (under review), according to age, qualifications and experience.

Informal enquiries may be made to Dr J. E. Saxton (Tel (0532) 431751 Ext 6070).

Application forms and further particulars may be obtained from and completed applications sent to:

The Registrar
The University
Leeds LS2 9JT

quoting reference number 45/43.

Closing date for applications 12 June, 1986.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE POSTDOCTORAL RESEARCH FELLOW

with experience in virology and/or molecular biology for a new three-year project to study antiviral compounds for the treatment of liver diseases. Starting salary up to £9802 (inclusive of London Weighting) on Research & Analogous Scale 1A.

Further particulars from the Personnel Officer, LSHTM, Keppel Street, London, WC1E 7HT to whom applications with full cv and the names of two referees should be sent by 15 May, 1986.

Enzyme Biochemist

Merck Sharp & Dohme Research Laboratories is a leading international research organisation which has recently established a Neuroscience Research Centre in a 30 acre park near Harlow, Essex. The Centre will be one of the world's largest laboratories dedicated to neuroscience research, initially focusing on the study of chemical messengers in the brain and exploration of the functional role of neuropeptides in the control of emotion, appetite, memory and learning.

As part of the Centre's planned growth we are now seeking an Enzyme Biochemist.

Candidates should either be PhD Biochemists with a minimum of two years post doctoral experience or graduates with several years post graduate experience, specialising in the isolation and characterisation of enzymes. Applicants should have experience of modern protein separation and purification techniques and immunological methods. The job will involve the development of new drug discovery programmes centred on enzymes involved in brain chemical messenger systems.

Our goal is to provide the facilities and compensation to enable the candidate appointed to devote their total endeavours to our research aims. If you feel that you meet our requirements, then write enclosing a full Curriculum Vitae to: Personnel Department, Merck Sharp & Dohme Research Laboratories, Neuroscience Research Centre, Terlings Park, Eastwick Road, Harlow, Essex CM20 2QR.



Neuroscience Research Centre

SOUTH GLAMORGAN HEALTH AUTHORITY

Llandough Hospital
PHYSIOLOGICAL
MEASUREMENT TECHNICIAN
Salary: £5091-£6816

To work in the Lung Function Laboratory at Llandough Hospital with duties on a rotational basis at Hospitals in Mid Glamorgan.

Applicants should possess a B Tec Certificate in Medical Physics/Physiological Measurement.

Full training will be given so candidates without these qualifications may apply.

For further information please contact Mr K. Houston, Senior Chief Technician. Tel (0222) 108601 Ext 5551.

Please apply in writing to: Personnel Department, Llandough Hospital, Penarth, South Glamorgan.

Closing date: 8 May, 1986.

A Bigger Career Choice in Technical Sales

If you are a life science graduate or have a paramedical background and want to succeed in a commercial environment leading to a managerial role, then phone us now on 01-222 1547.

**Ross Warren
Recruitment**

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iquid Crystals

Production Manager

BDH Limited is a major international supplier of Liquid Crystals. We are looking for a Chemist with PhD or equivalent experience to head the department responsible for the production of Liquid Crystals.

The position reports to the Works Manager and will be responsible for a team of qualified people who purify a large range of component substances to very high standards. These are then formulated into eutectic mixtures.

The successful applicant will be able to demonstrate a sound background in Organic Chemistry. Equally important will be the ability to identify and resolve problems, to achieve production targets and performance and maintain standards through the motivation and leadership of the production team. Specific knowledge of Liquid Crystals would be an advantage, but is not essential as comprehensive training will be given.

The Company is situated in a very attractive part of the country and this position carries a competitive starting salary and bonus together with other excellent conditions of employment.

Applications with full c.v. should be addressed in confidence to P N Hollingworth, Personnel Manager (Operations Group), BDH Limited, Broom Road, POOLE, Dorset BH12 4NN.



THE ROWETT RESEARCH INSTITUTE
Bucksburn, Aberdeen AB2 9SB
BIOCHEMIST-HSO/SSO GRADE
(Ref 3351)
(Three Year Appointment in the first instance)

A Biochemist is required to undertake new research on the regulation of phosphorus metabolism and the identification of the putative hormone(s) responsible for the adaptation in gastrointestinal and renal mechanisms for phosphorus absorption in ruminant animals. This work will involve the development of isolation procedures to identify novel effectors involved in phosphorus regulation, particularly at the level of the kidney.

The Biochemist will work in conjunction with other biochemists/endocrinologists with experience in polypeptide hormones, their catabolism and the identification of receptor activation and will be supervised by Dr P. Morgan. Biological experience of animal work is required as the research will be conducted in collaboration with physiologists.

Qualifications:— First or upper second class honours degree in chemistry/biochemistry/physiology, with at least two years relevant post-graduate experience for HSO grading and four years for SSO grading. Experience in polypeptide separation and analysis would be an advantage.

Salary Range:— HSO £7788-£10 541—SSO £9772-£12 653 (Under Review)
The position is supernumerary and the Institute is an Equal Opportunities Employer.

Applications in writing together with full cv and the names/addresses of two referees should be sent to the Secretary of the Institute from whom further particulars are available. Tel 0224-112751, Ext 338. Closing date 15 May, 1986.

RADIATION PHYSICS

up to £12 500.

Associated Nuclear Services, a firm of consulting engineers and scientists carrying out a wide variety of work for industry, government departments and international agencies, has vacancies in the Environmental Safety Department for suitably qualified scientists or engineers to work in the area of radiation physics.

Initially the work would be concerned mainly with the shielding design and/or the criticality safety assessment of major nuclear facilities. Opportunities will arise to work in other radiological areas.

Experience in radiation physics and with shielding or neutronics codes would be an advantage but is not essential as training would be given.

Application forms from Mrs G. Dorrington, Associated Nuclear Services, 60 East Street, Epsom, Surrey. Tel Epsom (STD 03727) 40531.

ANS

THE UNIVERSITY OF WARWICK
Department of Biological Sciences
POSTDOCTORAL FELLOW IN
ANIMAL MOLECULAR
GENETICS GROUP

Applications are invited for a three year appointment to work with Dr R. W. Old on a project funded by the SERC on the molecular biology of gene-specific transcription factors. This research involves recombinant DNA technology and microinjection of cloned DNA into *Xenopus* oocyte nuclei. Applicants with experience in any area of molecular biology would be considered. Further information can be obtained by telephoning Dr Old on Coventry (0203) 525358 (direct line). Salary will be on the Research 1A scale, £8020-£12 780 pa. Applicants send a full cv, with the names and addresses of two referees, to the Executive Officer/Academic Administration, Biological Sciences, Warwick University, Coventry CV4 7AL, quoting Ref No RWC/B8638.

SOFTWARE AND MARKETING SUPPORT IN DESKTOP PUBLISHING

An exciting opportunity to join a well-known multinational in the fastest growing sector of the micro industry-Desktop Publishing.

This important position involves evaluation and support of application software, marketing support for the direct sales force, and implementing new promotional ideas.

The successful candidate is likely to be a graduate with practical experience of microcomputing and working in a sales/marketing environment.

With a negotiable package up to £13k, plus the benefits associated with a major company, this position located in central London offers a challenging career move with growth potential.

For Confidential Interview Contact Paul Griffin 01-623-4688

UNIVERSITY COLLEGE CARDIFF
Department of Microbiology
POSTDOCTORAL RESEARCH FELLOW

Applications are invited for the above post. The person appointed will be involved in a collaborative AFRC supported research project with Cadbury-Schweppes, which will involve the investigation of carbon and energy metabolism of *Brettanomyces* (yeast spoilage organisms in carbonated beverages). Part of the project will be based at Reading. Further particulars are available from Professor D. Lloyd (0222 874268). Salary range RA 1A £8020-9498 pa. Duties to commence as soon as possible.

Applications (two copies), together with the names and addresses of two referees, should be forwarded to the Establishment Officer, University College, PO Box 78, Cardiff CF1 1XL, from whom further particulars are available. Ref 3082.

RESEARCH TECHNICIAN
required in Department of Cancer Studies, to assist in research programme involving use of tissue culture and other biochemical techniques. Applicants should be qualified in biological sciences/biochemistry at A level or equivalent and preferably have experience in tissue culture work. Reference 9232.

Salary £5685-5667 pa.
Applications from Personnel Office, Birmingham University, PO Box 363, Birmingham B15 2TT.
An Equal Opportunities Employer.

BIOCHEMICAL TECHNOLOGIST

Process Development STOCKTON-ON-TEES

Davy McKee Research & Development is the principal process development arm of Davy Corporation PLC in the UK. It plays a major role in maintaining Davy's position as one of the world's leading engineering contractors.

Modern well-equipped laboratories and a pilot plant facility on Teeside form the base of diverse process development activities. A challenging technical and commercial environment exists and it is into this that we wish to recruit an experienced biochemical technologist.

The successful candidate will, in this new position, carry the responsibility of advising on, and participating in R & D programmes for the application of biochemical techniques to a wide range of chemical, petrochemical and mineral processing technologies. Liaison with engineering specialists in our London and Stockton companies, client contact, and UK and overseas travel are also features of the appointment.

Applicants must have good first degrees, probably in a

BIOLOGICAL SCIENCE

or in

CHEMICAL/BIOCHEMICAL ENGINEERING

and be able to demonstrate an innovative capability. Four to six years relevant industrial experience is desirable.

We offer competitive salaries and other large company benefits including relocation assistance, if appropriate.

Please send a comprehensive CV or telephone or write for an application form to Norman E Nicholson.

Davy McKee, Research & Development, PO Box 37, Bowesfield Lane, Stockton-on-Tees, Cleveland TS18 3HA. Telephone: 0642 607108.



A Davy Corporation company

Organisation requires scientific and technical translators from Japanese to English.

Send replies to
BOX D 920

FIELD ASSISTANT

Required asap for research work on nightjars in Dorset. Own car essential £67/week plus accom. MSC conditions apply. Details from Stour Ringing Group, 101 Northport Drive, Wareham BH20 4DW.

LEO LABORATORIES LIMITED CAREER OPPORTUNITIES

Leo Laboratories Limited is part of the Leo Foundation, an International Organisation, dedicated to the research and production of fine pharmaceuticals and to the furtherance of medical research.

Expansion is responsible for the creation of the following openings in various departments:-

1. Clinical Research Associate

To assist in current and projected medical clinical trials of new and existing drugs. While previous experience is not essential, it is important that candidates have a good degree in a life science with, possibly, additional post-graduate study and a minimum of one year's work experience. Maximum age 30 years.

2. Veterinary Clinical Research Associate

Background, age and experience as for (1) above. In addition to clinical trials, the work involves some collation of information for registration purposes. A bright, enquiring mind is required for this position, which reports directly to the Veterinary R & D Director.

3. Assistant Medical Information Officer

To deal with internal and external enquiries and maintain an "in-house" data base. For this, a degree (obtained prior to 1985) is required, with major subject content from the following:-

Physiology-Microbiology-Biochemistry- Pharmacology.

The candidates are likely to have some library or information science experience, or have gained a further relevant qualification since graduating.

4. Clinical Trials Data Analyst

A life science graduate with statistical acumen to assist the Trials Documentation Manager in the computerisation and analysis of clinical trials.

All four positions mentioned above require first-class skills in verbal and written communication and a sense of commercial awareness.

In addition, vacancies exist in the following territories for:

MEDICAL REPRESENTATIVES

Brighton, Sussex

Southampton

East London/Dagenham

Bucks., Beds and Oxon

North West Lancs.

East South Wales

West South Wales

Wolverhampton

Derby/East Birmingham

For these positions, a degree in a life science (or equivalent) is required. Candidates should live near, or be prepared to move to one of the above areas. They should be people-oriented and be capable of exercising initiative in pursuance of their goals. Personal drive and the ability to express oneself clearly and precisely are also prerequisites.

Written applications, clearly indicating the position sought and containing a brief c.v. should be sent to:-

The Personnel and Training Director, Leo Laboratories Limited, Longwick Road, Princes Risborough, Aylesbury, Bucks HP17 9RR.



MORE VACANCIES ON PAGES

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FORENSIC SCIENTIFIC OFFICERS



**SALARY SCALE AP5 £10,638-£11,619
(Under Review)**

Applications are invited for 2 new posts in the Forensic Science Laboratory at Police Headquarters in Edinburgh.

Applicants will require an Honours Degree in either Chemistry or Biology or related subjects and have at least 2 years post-graduate experience, preferably gained in a Forensic Laboratory. Experience of presenting scientific evidence in court, while not essential, is desirable.

a) Forensic Chemist (for chemistry/toxicology sections)

Experience in the isolation and identification of drugs and the comparison of trace materials using a wide range of modern instruments is essential.

b) Forensic Biologist (for biology section)

Experience in serology, comparison of hairs and fibres and associated techniques is essential.

Applicants, male or female, should send a detailed C.V. to the Chief Constable, Lothian and Borders Police, Personnel and Training Department (Ref. 32/86), Fettes Avenue, Edinburgh EH4 1RB. Closing date 9 May 1986.

"We are an equal opportunities employer".

THE CAMPDEN FOOD PRESERVATION RESEARCH ASSOCIATION Chipping Campden, Glos GL55 6LD Department of Chemistry and Biochemistry **POST-DOCTORAL RESEARCH FELLOW**

A research post has recently become available to investigate an immunochromatographic approach to the sampling of food components and contaminants. The project will involve fundamental research to develop the use of antibodies for quick accurate sensing of low level contaminants of foods with a minimum of sample preparation in order to increase quality control. The ideal candidate will have a flair for method development, a working knowledge of immunology, and be able to manipulate electrochemistry and microprocessor control techniques. The essential characteristic will be an ability to develop an apparatus which will perform in the appropriate manner.

The appointment will be for two years in the first instance, and would be suitable for a recently qualified PhD but more experienced candidates will not be excluded. Informal enquiries can be made to Dr Andrew Scott (Tel: 0386 840319). Salary will be in accordance with experience.

Applications, enclosing a curriculum vitae and the names and addresses of two referees, should be sent to Dr Alastair Robertson, Head of Chemistry and Biochemistry Department, The Campden Food Preservation Research Association, Chipping Campden, Glos GL55 6LD.



Scientist Applied Research

Outstanding opportunity exists for a well above average scientist to join an important and profitable group of companies.

The appointed person up to 35 years of age, will be expected to be a source of innovation and expertise; to maintain a systematic study of all current processes and developments and to follow the research projects from the initial concept and exploratory experiments through to major trials.

Essential qualifications will be

- good honours degree in physics; - good innovative and inquisitive mind;
- experience in research and development, preferably in the continuous process industry; optics; visual phenomena; patent applications;
- ability to liaise with other disciplines, be lucid and communicate well at all levels to include customers and suppliers.

This is a Key Appointment which offers exceptional career prospects and a rare opportunity to contribute to technically advanced projects. The company offers excellent conditions of employment in the most congenial surroundings. Generous fringe benefits pension fund; life assurance, permanent health insurance, removal expenses and a salary which will be negotiable with the right person.

Apply in strict confidence quoting Ref No 5000.

Business Executive Technical Appointments

Braynrose House, Braynrose Street, Manchester 2.
16 St James's Place, St James's, London SW1.

Tel: 061-834 2594

Tel: 01-629 6074



FREELANCE EDITORS

Addison-Wesley are looking for regular freelance editors to work on their expanding list of tertiary-level computing and engineering text books.

Successful applicants will have a background in technical publishing and a good command of the English language. Wide experience in copy-editing and proof-reading, is essential and some knowledge of computer technology and programming languages is important.

Please apply with full handwritten cv to Paul Vinson, Production Director, Addison-Wesley Publishers Limited, Finchampstead Road, Wokingham, Berkshire RG11 2NZ.

TECHNICAL PROGRAMMERS ARE ALWAYS WANTED

Languages

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Applications

Numerical Analysis • Simulation • Mathematical Modelling • A.I. • Image Processing • Finite Elements • CAD/CAM and other engineering and scientific applications.

Positions throughout the South of England offering salaries of £20,000 - £22,000.

Please phone for an Application Form or write with details listing phone numbers for contact.

AMES PERSONNEL, 4A BIRKHEADS ROAD, REIGATE, SURREY RH2 0AR
TELEPHONE: REIGATE (073 73) 22491

AMES PERSONNEL

UNIVERSITY OF WALES INSTITUTE OF PSYCHIATRY Department of Neuropsychiatry SCIENTIFIC OFFICER

Required to work on the role of cerebral endothelial cells in the development of immune reactions in the brain. Previous experience of tissue culture, immunology or immunocytochemistry required. The project is funded by the MRC for three years and the appointment will be for one year in the first instance.

Whitley Council conditions of service and salary in the range £6000-£7400 pa plus £1084 pa London Weighting.

For further information contact Dr David Males (Tel 01-703 5411, Ext 353). An application form may be obtained from the Assistant Secretary, Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AF, quoting Ref DM/NS. Closing date for applications: 8 May, 1986.

CAREER OPPORTUNITIES AT VG MASSLAB FOR

PHYSICISTS

The expansion of VG MassLab, a member of the VG Instruments Group of Companies, has created further opportunities for Physicists in the field of organic mass spectrometry.

The Company produces research grade analytical instruments and associated data systems for commercial laboratories throughout the world, and successful candidates would join a young, progressive team, of specialists dedicated to upholding the internationally recognised reputation of the VG Instruments Group.

Applicants should be self motivating, qualified to at least degree level and be able to demonstrate practical application in their discipline. Experience of instrumentation development and/or ion optics would be an advantage. An attractive salary with usual fringe benefits is offered, together with a real opportunity for career development in a growing and increasingly important field of analytical science.

Applicants male/female should apply in writing with full C.V. to:

VG MASSLAB Automated mass spectrometry

Dr. Charles Smith VG MASSLAB Ltd.,
Tudor Road, Altrincham, Cheshire, WA14 5RZ



COUNTY SURVEYOR AND ENGINEER'S DEPARTMENT

SENIOR SCIENTIST SO/PO(36), £9975-£12 168

To provide scientific support for the activities of the Waste Disposal Section. Applicants should be professionally qualified in a mainstream scientific discipline with good practical experience in the fields of industrial chemistry and if possible hydrogeology. Will be expected to work on a range of projects including leachate and methane control systems, monitoring of wastes and the environment. Management experience an advantage.

Based in Oxford. Car allowance, separation allowance and assistance with removal expenses payable in appropriate cases.

Application forms (to be returned by 9 May, 1986) from County Surveyor and Engineer, Speedwell House, Speedwell Street, Oxford OX1 1NE or telephone Mr B. Church on Oxford 815702

**Oxfordshire
County Council**
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ilea Inner London Education Authority

SCIENCE TEACHERS FOR SEPTEMBER 1986 APPOINTMENTS

In May 1986 the ILEA becomes the first directly elected education authority. All the efforts and resources of this unique Authority will be aimed at providing an innovative education service of the highest quality with the promotion of equal opportunities as a major priority.

We would welcome applications for a variety of posts in this exciting inner city environment both from teachers currently completing their training and from experienced teachers.

We are offering permanent Scale 1 posts in BIOLOGY, CHEMISTRY, INTEGRATED SCIENCES and PHYSICS. We will be making many offers of posts to suitable candidates immediately after interview. We offer:

- Half day a week Induction training for probationers.
- Wide-ranging support, excellent resources and a high level of in-service training provision.
- Pupil Teacher Ratios among the best in the country.
- Inner London allowance of £1038 in addition to Burnham salary. Further increase pending.
- Capital city location with all its amenities and opportunities.
- Job share opportunities for experienced teachers.

You are advised to apply as early as possible. Telephone for an application form and ask to speak to Denise Parker or Derek Reid on

01 633 2101
or 01 633 7427

Alternatively write to EO/TS2, Room 67(MB), County Hall, London, SE1 7PB. Please state if you are seeking your first teaching appointment.

ILEA IS AN EQUAL OPPORTUNITIES EMPLOYER

SCIENTIFIC OFFICER

Algologist/Microbiologist

Scientific Officer to assume day-to-day responsibility for the maintenance and development of a culture collection of algae, comprising the marine algae of the National Culture Centre of Algae and Protozoa, shortly to be located at the Scottish Marine Biological Association, Dunstaffnage Marine Research Laboratory. The successful candidate will be directly responsible to the Curator of the Collection and will be expected to participate on associated taxonomic and physiological research. The appointment will be for a period of four years in the first instance; salary range £6190-£8561. Candidates should possess a first degree in microbiology or biological science with a strong background in microbiology; also desirable but not essential are some experience in an industrial, hospital or academic research environment and familiarity with the culture of photosynthetic micro-organisms.

Application forms from: Mr Bill Hall, Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wilts. SN2 1EU. Tel: Swindon (0793) 40101, Ext 423.



BP is one of the largest international energy and natural resources groups in the world. The company conducts a wide range of research and development activities in support of existing business areas and for the identification of new business opportunities. BP's strong commitment to R & D on new energy sources has led to the creation of additional posts for:

Development Technicians

Up to £11,000 plus benefits

You will be required to fabricate and test new photovoltaic products based on advanced materials, in support of BP's solar operations which have sold electrical power systems in over 50 countries. These posts will provide exciting challenges within a stimulating project where individual skills will be used to the full.

For all posts, you should be aged 22-40, and normally possess a HTEC or equivalent in chemistry, physics or an engineering discipline. Ideally, you should also have some experience of materials/process development work.

An excellent remuneration package includes a bonus scheme, contributory pension scheme and relocation assistance where applicable.

Please write or telephone for an application form, quoting reference **BV PS4** to: Anne Sheppard, BP Research Centre, Chertsey Road, Sunbury-on-Thames, Middlesex TW16 7LN. Tel. Sunbury-on-Thames (0932) 762028.

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BP

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UNIVERSITY OF LIVERPOOL Institute of Child Health LECTURER IN EPIDEMIOLOGY (SPECIAL APPOINTMENT)

Applications are invited for the post of Lecturer (Special Appointment) in Epidemiology to conduct research in the epidemiology of congenital Malformations. The post is tenable for five years and is funded on a programme grant to Professor F. Harris by the Office of the Chief Scientist at the DHSS. The successful candidate will have expertise in Biostatistics and a knowledge and interest in Epidemiology.

Initial salary within the range £8020-£10 375 pa.

Prospective candidates are invited to contact Professor F. Harris, Institute of Child Health, Royal Liverpool Children's Hospital (Alder Hey), Eaton Road, Liverpool L12 2AP. Tel 051-228 4811, Ext 435.

Applications, together with the names of three referees, should be received not later than 16 May, 1986, by The Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained. Quote ref RV/726/NS.

VETERINARY MICROBIOLOGIST

Applications are invited for the above post in a Veterinary Laboratory in Dubai. Applicants should have a registrable qualification and good experience in the above field.

Duties include laboratory diagnosis of Bacterial, viral, fungal and parasitic diseases in animals, with special reference to camels, horses and falcons.

Salary will be good and in accordance with qualifications and experience. Applicants are asked to send a letter of application and a full cv, names and addresses of two referees, to

Mr Ali Ridha
Senior Biochemist
Dubai Hospital
PO Box 7272
Dubai, UAE

BOTANIST

To join team of Ecologists on Montgomery Canal and Environment near Shrewsbury.

32 Hour week. £88.00, applicants must be currently unemployed and eligible for the Community Programme.

Applications to:
Community Task Force,
Castle Park, Evans Street,
FLINT, Chwyd.

GEOLOGIST

Required immediately to index geological literature for GeoArchive, a computerised geoscience bibliography at BGS, Keyworth, Notts. Send cv to Colin Beavington, Geosystems, PO Box 1024, Westminster, London SW1.

LIVERPOOL POLYTECHNIC

Department of Chemistry and Biochemistry

READER (BURNHAM SCALE)
P.L. £14 013-£17 619

Re-Advertisement

The successful candidate must have a proven research record and be able to demonstrate an ability to attract external funding for research projects.

He/She will act as Research Co-ordinator and will be responsible for sustaining and expanding the research activities of the Department, in addition to performing some teaching duties.

Previous applicants will be automatically re-considered.

For further particulars and an application form contact the Personnel Officer, Liverpool Polytechnic, Rodney House, 70 Mount Pleasant, Liverpool, L3 5UX (Tel 051-207 3581 Ext 2518/2519) to whom applications must be returned not later than Thursday, 15 May 1986.

Liverpool Polytechnic is an Equal Opportunity Employer and welcomes applications irrespective of race, sex, marital status or disability.

UNIVERSITY OF BATH

School of Materials Science

COMPOSITE MATERIALS RESEARCH

Applications are invited from graduates in materials, engineering, or physical science disciplines for Research Officer posts on the following investigations:

- (i) Acoustic emission testing of filament-wound pipes, (one year initially) Ref No 86/67.
- (ii) Environmental stress-rupture of laminates (one year) Ref No 86/68.
- (iii) Properties of new phenolic resin composites (three years) Ref No 86/69.

Preference will be given to candidates with proven industrial or research experience.

Salary up to £9495 pa according to age and experience.

Application forms from the Personnel Officer, University of Bath, Bath BA2 7AY, quoting the appropriate ref no Closing date 15 May, 1986. Informal contact may be made with Mr. G. Phillips (Ext 432) on 0225 61244.

THE ROYAL MARSDEN HOSPITAL

Fulham Road, London SW3

MLSO/JUNIOR 'B'-MICROBIOLOGY

The Laboratory provides a diagnostic service for a 200 bed hospital, a high proportion of patients having either major surgery or cytotoxic chemotherapy. Many also have disease-induced immunosuppression.

A voluntary 'out of hours' service exists and the postholder will be asked to participate.

Applicants should possess at least B TEC NC or equivalent and have some experience in clinical microbiology.

Salary £3782-£8477 pa, according to qualifications and experience, plus £1133 Inner London Allowance.

Informal visits are encouraged and can be arranged by contacting Michael Millett, Chief MLSO, Tel 01-352 8171 Ext 247. Application form and job description available from the Personnel Department at the above address, or Tel 01-352 446447. Closing date: 22 May, 1986.

Environmental Services
Temporary
Technical Officer
 (Pollution Control)
 £7551-£8073 inclusive

To assist in work dealing with the control of noise and atmospheric pollution. The work will principally involve the assessment/removal of asbestos and subsequent laboratory determinations, but the applicant may need to become involved in all aspects of pollution assessment at the field/laboratory interface.

Experience of qualifications in these fields is required, but further specific training will be available. It is a requirement of the post that some work will need to be undertaken in 'unsocial hours'.

Casual car allowance payable.

A thorough and mature approach to the work is essential, together with the ability to communicate with people.

For more information or an informal discussion, please contact Paul Reynolds on 748-3020, Ext 3960.

Application forms from London Borough of Hammersmith and Fulham (Personnel), Town Hall Extension, King Street, Hammersmith W6 9JU, telephone 01-741 0904 (24 hour answering service) quoting ref: NFS2. Closing date: 8 May, 1986.

Hammersmith & Fulham
 An Equal Opportunity Employer

Technician (Analytical Laboratory)

Our Research and Development Centre at Maidenhead is expanding and as a result a vacancy has arisen for a Technician in the Analytical Laboratory.

The successful candidate will assist the Laboratory Manager in providing a analytical service to the Research and Development Centre and also to other sectors of the United Biscuits Group. Applications are invited from graduates (or equivalent qualification in Chemistry or food related subjects) with an interest in food analysis.

Applicants must have at least two years' experience in a food or food related laboratory.

Preferred age range 23-28 years.

The Centre will be moving to new purpose built laboratories in the Thames Valley area sometime in 1987.

Benefits for the above vacancy include attractive salary, over four weeks' holiday and generous pension and life assurance schemes.

Please write or telephone (quoting job and ref T/AL) for application form and job description to Miss F. Molony, H.Q. Personnel/Welfare Officer, United Biscuits (UK) Limited, Grant House, PO Box 40, Syon Lane, Isleworth, Middlesex TW7 5NN. Tel: 01-560 3131, Ext 4244.



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UNIVERSITY OF BRADFORD
Research Assistantship
in Chemical Engineering

Applications are invited for a two-year post funded by SERC which is available for studies of novel oil coating techniques in conjunction with Bone Markham Limited. Candidates should hold good Honours degrees in Chemical Engineering, Mechanical Engineering, Physics or a related discipline. Interest in fluid mechanics advantageous. Opportunity to register for higher degree. Commencing salary £7055 p.a. Superannuable. Application forms and further details may be obtained from the Deputy Secretary (Ref. RA/CHE/B/NS), University of Bradford, West Yorkshire, BD7 1DP. An Equal Opportunity Employer. Informal enquiries to Dr H. Benkreira (Tel 0274-733466 Ext. 7430). Closing date 15 May, 1986.

UNIVERSITY OF LEICESTER
Department of Genetics
GRADE 3 TECHNICIAN

The Department has a vacancy for a grade 3 technician for two years. The position (joint with Celltech Ltd) will be mainly concerned with research in the general field of molecular biology with a specific interest in haemolysis secretion from E. coli. Applicants should have either a degree, TEC or equivalent qualifications. Relevant experience (DNA manipulation) would be an advantage.

Salary on the scale £5683-£6657: appointment to be immediate. Please apply in writing with full cv and names of two referees to the Chief Technician, Department of Genetics, University of Leicester, Leicester LE1 7RH.

COASTAL MODELLER

The use of numerical models of the coastal and maritime environment plays an increasingly important part in design. Halcrow Maritime provides models for dealing with all aspects of the marine environment. This includes wave generation and propagation phenomena, wave induced currents, tide and wind induced water levels and currents, dispersion of heat and pollutants and movement of sediment in coastal and estuarial areas. Thus traditional design is integrated with advanced numerical techniques and great emphasis is placed upon the validation and calibration of these models.

There is an immediate requirement for an additional member of staff to join the Department at Burderop Park, near Swindon, Wiltshire.

Applicants, aged 24 to 30, may hold engineering, science or mathematics degrees. Numerical modelling/programming experience will be looked for and experience in maritime and coastal engineering will be advantageous.

Burderop Park is located in attractive rural surroundings south of the M4 near Swindon and offers excellent working conditions. Salary will be related to age and experience.

Please write enclosing CV to P. R. Jackson.

Sir William Halcrow & Partners,
 Vineyard House,
 44 Brook Green,
 London W6 7BY.

HALCROW



LOUGHBOROUGH
UNIVERSITY
OF TECHNOLOGY

Department of
Transport Technology

RESEARCH ASSISTANT IN NUMERICAL OPTIMISATION

Applications are invited from candidates with a good Honours degree in Mathematics, Engineering or Physics and a strong interest in computing.

The post is funded by SERC and is part of a co-operative programme with Perkins Engines Ltd, aimed at developing theoretical procedures and computer programmes for the dynamic optimisation of the vibration and noise response of engine structures. Expertise in numerical analysis is the main requirement of the post; experience with either finite element methods or computational structural dynamics would be advantageous.

Funding is available initially for two years on either the IB scale or the IA scale at a salary up to £9495 (under review) depending on age and experience.

Further particulars and an application form available from Mrs B. N. Moore, Secretary, Department of Transport Technology, LOUGHBOROUGH, Leics LE11 3TU. (Closing date 23 May, 1986).
 Loughborough Leicester

MORE VACANCIES ON PAGES

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Research Posts in Communications Engineering

Applied scientists and communications engineers are required to assist with experimental communications projects concerned with radio propagation investigations and satellite communication research projects. A successful researcher would develop a knowledge of radio communications systems, radio meteorology, data analysis techniques and electro-magnetic wave theory, although applicants need not initially have these experiences. The scope of the experimental programme, which is of both national and international importance, covers satellite and terrestrial communications systems, mobile radio and broadcasting.

Qualifications:-

SO - Degree, HNC/HND or equivalent in a scientific, mathematical or engineering subject.
HSD - 1st or 2nd class Honours degree with 2 years postgraduate research or development experience; applicants with a degree or equivalent qualification require a minimum of 5 years relevant experience after qualifying.

HPTO - Degree or equivalent qualification with at least 2 years professional training and experience.

Appointments will be made in one of the following grades depending on qualifications and experience.

Scientific Officer	£6190 - £ 8561
Higher Scientific Officer	£7788 - £10541
Higher Professional and Technology Officer	£8500 - £10750

These are pensionable appointments.

Contact Recruitment Officer, Personnel Group, Rutherford Appleton Laboratory, Science and Engineering Research Council, Chilton, Didcot, Oxon OX11 0QX. Tel: (0235) 445435, or J R Norbury (0235) 445508 for more technical information, quoting reference VN436.

Closing date for applications: 15th May 1986



Rutherford Appleton Laboratory

LANCASHIRE POLYTECHNIC at PRESTON

Applications are invited for the post of:

LABORATORY/WORKSHOP TECHNICIAN (SCALE 3 OR SCALE 4/5)

for two years from 1 September, 1986.

Candidates should have at least an HNC or HND in Biological Sciences with some specialisation in microbiology or plant physiology or biochemistry.

Salary Scale 3 £2624-£2756 or **Scale 4/5** £2890-£2997 plus up to £132 pa for possession of appropriate qualifications.

361 hour, five day week.

Application forms and further details obtainable from the Personnel Office, Lancashire Polytechnic, Preston PR1 2TQ, Telephone: (0772) 282027.

Please quote Post Reference No NY/86/87/3.

Closing Date: 23 May, 1986.

LOTHIAN HEALTH BOARD BASIC GRADE BIOENGINEER

(research post funded for two years only) to continue development of a silicone polymer cosmetic glove leading to manufacture and commercial production of improved hand prostheses for NHS patients. Based at the Bioengineering Centre, Princess Margaret Rose Orthopaedic Hospital, Edinburgh.

An honours degree in chemical, materials, mechanical engineering, or other relevant subject required. Salary, depending on qualifications and experience, on NHS scale £6288-£9432.

Further particulars from The Area Personnel Officer, 11 Drummaugh Gardens, Edinburgh EH3 7QQ to whom typed cv with the names and addresses of two referees should be sent by 8 May, 1986. Quote M/61.

TOP GRADE BIOCHEMIST (Salary £19 133-£22 633)

For Department of Chemical Immunology of Westminster Hospital, Riverside Health Authority, where a supra-regional and regional protein reference service is provided.

Candidates should have at least a PhD or MCB or MRCPath and in depth experience with human proteins. Collateral knowledge in immunology appreciated CV and application (three referees with Tel Nos) to Personnel Officer, Westminster Hospital, London SW1P 2AR to arrive before 19 May, 1986. (Enquiries Tel 01-828 4128).

SERVICES

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 London N11 2E2

FELLOWSHIPS, GRANTS & SCHOLARSHIPS

ANTI-CANCER FOUNDATION OF THE UNIVERSITIES OF SOUTH AUSTRALIA

FELLOWSHIPS IN CANCER RESEARCH

Applications are invited from males and females for three Fellowships in Cancer Research which will fall vacant during the latter part of 1986, and early part of 1987. One of the Fellowships requires that the occupant must undertake studies in the field of leukaemia research, preferably in the field of adult leukaemia.

The successful applicants will work in South Australia in either a hospital, research laboratory or university department.

Eligibility: The fellowships are intended to support persons below age 35 who are well established in a research career, as assessed by published works and reports of referees.

How to apply: Applicants should first correspond with the head of department in one of the relevant institutions in South Australia and submit a research project which is acceptable to that department and to the applicant's own interests and previous experience.

Applications should be submitted directly to the Foundation, and should include two copies of a detailed research project and of the candidate's cv, which should include a list of published work, grants received and outline of previous research experience. The names of three referees should be included.

Selection: Selection will be based on an assessment of the applicant's record and the scientific worth of the research project. An interview will be conducted with the applicant (or nominee if the applicant resides outside Australia) following satisfactory reports by outside assessors. **Salary and conditions:** The salaries being offered will commence between £427 233 and £435 777, depending on past experience and qualifications and will thereafter follow the Research Fellow scales of the universities of South Australia.

The three-year period of appointment is not renewable. Maintenance grant: up to £43 000 per year. The institution where the work is carried out will determine all other conditions of employment.

Applications should be addressed to: The Chief Executive Officer, Anti-Cancer Foundation, Rundle Mall, PO Box 35, Adelaide, South Australia 5000 (Tel (08) 228 5070). Closing date: 31 July, 1986.

SUNDERLAND POLYTECHNIC Department of Pharmaceutical Chemistry POSTDOCTORAL RESEARCH FELLOWSHIP IN COMPUTER GRAPHICS/DRUG SYNTHESIS

Salary: £9543 pa

For a BTG funded post, on the design and preparation of potential antiviral agents, in the multidisciplinary team headed by Professor J. R. Brown. The appointment is for 12 months and is suitable for someone with a background in organic chemistry and an interest in computing or for someone with experience of computer graphics applications in chemistry.

Application forms and further particulars obtained from Personnel Officer, Sunderland Polytechnic, Langham Tower, Ryhope Road, Sunderland SR2 7EE or Tel (0783) 76231, Ext 11.

Closing date: 7 May, 1986.

UNIVERSITY OF BIRMINGHAM

Faculty of Science

Department of Biochemistry
—two postdoctoral Research
Fellowships

PROTON EFFLUX FROM
BACTERIAL MEMBRANES
DURING PHOTOSYNTHESIS (B3)

Applications are invited for the above post, funded by the SERC in the laboratory of Dr J. B. Jackson. The project aims to characterise the components responsible for proton release from bacterial membranes after excitation with short flashes of photosynthetic light and establish the role of proton translocation in the bioenergetics of the organism. It will involve short time resolution, computer-controlled spectroscopy, aspects of membrane biology and bacterial mutagenesis by transposon insertion. Applicants should have experience in these disciplines or a good background in microbiology. Tenable for up to three years.

BIOCHEMICAL TOXICOLOGY
(B22)

Applications are invited for the above post supported by the MRC, to study the activation of pro-mutagens by animal and human hepatocytes and the effect of antioxidants. Applicants should have a relevant background in Biochemical Toxicology. Tenable for up to 21 months.

Both posts are tenable from as soon as possible on the Research Fellow scale £8020 to £12 780 plus superannuation. For further particulars Tel 021-472-1301 Ext 2559, quoting reference number given above.

Three copies of application, including a cv and the names of three referees should be made by 9 May, 1986 to the Assistant Registrar, Faculty of Science, University of Birmingham, P.O. Box 363, Birmingham B15 2TT.

An Equal Opportunities Employer.

CLARE HALL

Research Fellowships in Physical
and Biological Sciences

The Governing body of Clare Hall intends to elect three non-stipendiary Research Fellows for a period of three years, starting not earlier than October, 1986, to work in mathematics, the physical or biological sciences, earth sciences or technology. There are no restrictions on age or sex.

The closing date for the receipt of applications and references is 26 June, 1986.

Application forms may be obtained from Clare Hall, Heneage Road, Cambridge (Tel Cambridge 332360).

THE INSTITUTE OF

CANCER RESEARCH

Applications are invited from postdoctoral crystallographers for A THREE YEAR FELLOWSHIP

in the first instance from 1 October, 1986 in the CRC Biomolecular Structure Unit based in Sutton, Surrey. Current areas of activity include: drug-oligonucleotide complexes, structure-activity relationships of anti-tumour drugs, and macro molecular crystallography. Applicants should have expertise in diffractometric data collection and structure solution methods.

Salary in the range £9495-£15 700 pa plus London Allowance of £1297. Enquiries may be made to Dr S. Neidle, Tel 01-843 8901, Ext 251.

Applications in duplicate, with the names and addresses of two referees to be sent to the Personnel Officer, The Institute of Cancer Research, 17A Orskov Gardens, London SW7 3AL, quoting ref 4/86/S/NS/14.



Royal Military College of Science
Shrinvenham

RESEARCH
FELLOWSHIPS/ASSISTANTS

The Schools of
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and
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are seeking a number of self motivated graduates to assist in developing and expanding certain areas of research. They will be expected to join existing teams, or develop their own particular subject, in areas such as computational aerodynamics, supersonic aerodynamics, design of structures to resist blast loading, robotics autonomous vehicles, vehicle power trains, active suspension systems, vehicle structures, CAD/CAM/CAL, advanced composite materials, pyrotechnics, propellants, explosives, environmental monitoring, contamination control, lubrication, small arms, command and control systems, microwave circuits and systems engineering, fault tolerant software, KBS/Expert systems, wideband communications, speech signal processing, image processing, electrical drives, electrical properties of polymers, laser applications, vibration and seismic research, and thermal imaging systems. Under certain circumstances candidates may be permitted to undertake their own suggested line of research.

Suitable candidates will be expected to have a good honours degree or higher qualification and may be able to register for a higher degree. The appointment will be initially for two years at a point within the following salary scales:

Range 1B	£7055-£9495
Range 1A	£8020-£12 780
Range 11	£11 790-£15 700

Application forms are available from the Personnel Office (HQ) RMCS Shrinvenham, Swindon, Wiltshire SN6 8LA. Tel (0793) 782551, Ext 2421/2403, quoting ref MMCE 4/86 or SEES 7/86.

Closing date 29 May, 1986.

THE POLYTECHNIC OF WALES

POLYTECHNIC CYMRU

Department of Chemical

Engineering

POSTDOCTORAL RESEARCH
FELLOWSHIP

Applications are invited for a Post-doctoral Research Fellowship, tenable for a period of three years, for a project concerned with fast scanning FTIR spectroscopy applied to the combustion of energetic materials. Candidates should be graduates in Chemistry/Physics with doctoral/postdoctoral experience in the use of FTIR spectroscopy techniques, and preferably combustion chemistry. Additionally experience in the application of computer techniques for the processing/analysis of emission spectra would be an advantage.

Salary will be £8076-£11 433 (under review) depending on age, qualifications and experience.

Further details and application forms may be obtained from The Personnel Office, The Polytechnic of Wales, Pontypridd, Mid Glamorgan CF37 1DL Tel (0443) 405133, Ext 2021.

Personal enquiries may be made to Dr G. J. Storr on Ext 2288.

Closing Date: 15 May, 1986.

Cranfield

University of Oxford
Department for External Studies

OXFORD SCIENCE
STUDIES SUMMER
SEMINAR

At the Queen's College, Oxford

FUTURES FOR
SCIENCE
(12-19 July)

A discussion of science and technology, policy, funding, and alternative agendas for science; speakers include Prof Sir David Phillips and Jonathan Porritt.

SCIENCE AND BELIEF
(19-26 July)

New perspectives on Science and religion; speakers include Revd Dr Don Cupitt, Mrs Mary Midgley and Dr Arthur Peacocke.

Seminar fee: £35

Accommodation fee: £140

Further information from Dr J. R. Durnat, OUDES, 1 Wellington Square, Oxford OX1 2JA; Tel (0865) 52901.

The West of Scotland
Agricultural CollegeBECOME A GRADUATE
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Application Forms may be obtained from

The Academic Registrar,

The West of Scotland

Agricultural College,

Auchincruive, Ayr KA8 5HW.

Tel (0292) 520331

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London W5.

LECTURES, MEETINGS

AND COURSES

UNIVERSITY OF STIRLING

Departments of Management Science and Economics

PhD RESEARCH

Applications are invited from scientists and engineers for work on:

waste re-cycling
inter-nation innovation and technology transfer
modelling of process plant availability
economics of machine translation
economics of robotization
SERC studentships may be available.

Details from:

M. Makower, FOR, F.INST Petroleum
Technological Economics Research Unit
University of Stirling
STIRLING FK9 4LA

SCOTTISH
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SCHOOL



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Awards are available for applicants with a 1st or 2nd class honours degree in a science or engineering discipline. A preliminary foundation year is undertaken by those with a pass degree, HND or equivalent.

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Dr. J. P. Chubb, School of Industrial Science, Cranfield Institute of Technology, Bedford MK43 0AL. Tel: 0234 750111 ext. 2529

Name
Address

Please send me full Course information.

School of Industrial Science



AWARDS

UNIVERSITY OF LIVERPOOL School of Chemistry

Applications are invited for the following SERC studentship for candidates who have obtained, or expect to obtain, a first or upper second class honours degree in chemistry or a related subject.

Enquiries may be made to Dr R. J. Abraham.

A MOLECULAR MODELLING AND NMR INVESTIGATION OF POLYMER CONFIGURATION

This project is with ICI (Petrochemicals Division) and involves computer modelling and nmr studies of some commercially important polymers.

Applications, together with the names of two referees, should be received as soon as possible by The Registrar, University, PO Box 147, Liverpool L69 3BX. Quote Ref RV/723/NS.

UNIVERSITY OF LEICESTER CELL/TECH

SERC Collaborative Award DOCTORAL AWARD

A postdoctoral position is available for immediate appointment for two years to study haemolysin secretion from *E. coli* using DNA recombinant techniques. The project would be carried out primarily in Leicester with an expanding group of scientists working on related aspects of the haemolysin system. Applicants should have some experience of DNA manipulation techniques.

Salary will be in the range \$8020-112 780 (RAIA) depending upon age and experience.

Please send brief cv with names of two referees and requests for further details to Professor I. B. Holland, Department of Genetics, University of Leicester, Leicester LE1 7RH.

STUDENTSIPS

UNIVERSITY OF NOTTINGHAM MEDICAL SCHOOL

Department of Physiology and Pharmacology
**FRAME RESEARCH
STUDENTSIP**

Applications are invited for a SERC-sponsored studentship for research into the metabolism and toxicity of xenobiotics in mammalian cultured cells. The studentship will be tenable for up to three years from 1 October, 1986 with a view to reading for the degree of PhD. Candidates should hold, or expect to obtain in 1986, a first or upper second class honours degree in Pharmacology, Biochemistry or a related subject. The terms and conditions of the studentship will be similar to those offered by the MRC/SERC.

Applications, including a cv and the names of two referees, should be sent without delay to Dr J. R. Fry, Department of Physiology and Pharmacology, Medical School, Queen's Medical Centre, Nottingham NG7 2UH (Tel 0602-700111, Ext 3197) from whom further information may be obtained.

BIRKBECK COLLEGE (University of London)

SERC STUDENTSIP
Applications are invited for a SERC studentship, to commence as soon as possible, on the effects of drug and ligand binding on the stability and dynamics of nucleic acids. Candidates must have, or expect to obtain this year, a first or upper second class honours degree.

Further details and application form can be obtained from Dr J. M. Goodfellow, Department of Crystallography, Birkbeck College, Malet Street, London WC1E 7HX (or Tel 01-631 6284).

BIRKBECK COLLEGE (University of London) Department of Chemistry NMR RESEARCH STUDENTSIPS

Applications are invited for two CASE research studentships mainly involving high-field NMR studies of the structures, conformations and interactions of molecules in solution. Access to 200 MHz and 500 MHz spectrometers is available.

1. AFRC (with Dr E. B. Rathbone, Tate and Lyle Group R and D, Reading)

Topic: Spectroscopic studies of the molecular basis of taste.

2. SERC (with Dr C. Elliott, ICI Plant Protection Division, Bracknell and Dr C. Jones, NIBSC, London)

Topic: NMR studies of carbohydrate conformations, with particular reference to the antigenic polysaccharides.

Candidates should have, or expect to have, a first or upper second class honours degree or equivalent qualification in Chemistry or a Chemistry-related subject.

Applications (including a cv and the names of two referees) should be sent as soon as possible to Dr D. B. Davies at Birkbeck College, Malet Street, London WC1E 7HX (Tel 01-631 6253).

UNIVERSITY OF OXFORD Department of Plant Sciences

SERC CASE STUDENTSIP IN NMR SPECTROSCOPY

Applications are invited for a three year CASE studentship under the joint supervision of Dr R. Ratcliffe (Oxford University) and Dr W. A. Hughes (Unilever Research, Colworth Laboratory, Bedford). The research project involves the use of high resolution NMR spectroscopy as a non-invasive technique for studying plant cell metabolism in suspension cultures. Applicants should have, or expect to obtain, a good honours degree in chemistry, biochemistry, or a related subject, and a strong interest in the application of physical methods to biological systems would be an advantage.

The studentship is available from 1 October, 1986 and the successful applicant will be expected to register for a higher degree. Further information can be obtained from the Administrator, Department of Plant Sciences, Agricultural Science Building, Parks Road, Oxford, OX1 3PF. Applications, including the names of two referees, should be sent to the same address as soon as possible.

BIRKBECK COLLEGE (University of London) SERC BIOTECHNOLOGY STUDENTSIP

COMPUTER MODELLING FOR PROTEIN ENGINEERING

Applications are invited for an SERC Biotechnology Directorate studentship for PhD research. The topic is involved with the establishment of rules to guide protein engineering using data bases, energy calculations and computer graphics.

Applicants should hold, or expect to obtain, a First or Upper Second Honours degree in Physics, Chemistry, Biochemistry, Biophysics or Information Technology. Please apply to Dr Mike Sternberg, Department of Crystallography, Birkbeck College, Malet Street, London WC1E 7HX enclosing brief cv and the names of two academic referees or telephone the Departmental Secretary on 01-631 6284.

UNIVERSITY OF LANCASTER DEPARTMENT OF CHEMISTRY SERC CASE STUDENTSIPS AND OTHER RESEARCH OPPORTUNITIES

Five SERC CASE studentships are available for those leading to the degree of PhD in the following areas:

1. **Amphiphilic Liquid Crystall Polymers**—Dr Hodge in collaboration with ICI New Science Group.
2. **Precursor Polymers 1**—Dr Hodge in collaboration with New Science Group.
3. **Precursor Polymers 2**—Dr Hodge in collaboration with New Science Group.
4. **Asymmetric Organic Synthesis in Heterogeneous Systems**—Dr Hodge in collaboration with ICI Organics Division.
5. **Alkaline Hydrolysis of Ketansin**—Dr Thomson in collaboration with ICI New Science Group.

Candidates for the above awards should possess, or expect to obtain shortly, upper second or first class degrees in Chemistry or equivalent qualifications. All the awards will be supplemented with additional sums from the collaborating companies.

Notes that awards 1-3 are being made in connection with a funded programme in Polymer Synthesis. It is expected that a number of other PhD Studentships and also Research Fellowships will be available. Anyone interested in any of the Studentships or Fellowships, or other research opportunities in the Polymer Synthesis programme, should contact as soon as possible.

Dr P. Hodge, (Head of Department, Department of Chemistry, University of Lancaster LA1 4YA (Tel 0524 65201 Ext 4095).

UNIVERSITY OF ABERDEEN DEPARTMENT OF CHEMISTRY, ABERDEEN AB9 2UE

RESEARCH STUDENTSIPS

Applications are invited from Chemists, Materials Scientists, Geochemists, etc. as appropriate for the following areas:

SERC CASE 1. "Cement Reactions in Hydrothermal Conditions, as found in Oil Wells." (Professor F. J. Glasser/Borus Research).

2. "The Role of the Mechanism of Autoxidation of Alkyl Resins in Water-Borne Paints." (Professor A. R. Forrester/ICI).

3. "The Role of Alkyl Radicals in the Radical Isomerisation in the Autocatalysis of Polyisobutylene." (Dr L. Best/Shell).

4. "The encapsulation of Organotin Compounds for controlled Release." (Dr J. L. Wardell/Int. Tin Research Centre).

SERC—Quoted Studentships are also likely to be available in areas such as Solid State, Polymer and Biological Chemistry, and Vibrational Spectroscopy.

Also Available is a Studentship, for one year in the first instance to study "Curable Acrylic Polymers." (Professor G. G. Cameron/Reynolds Chemicals Ltd.).

Applicants should write directly to the Superintendent, above, enclosing a brief cv (Ref 40241 Ext 5625, for further details such as qualifications required).

Miss Dorothy Noble, Dept of Chemistry, University of Aberdeen, Marischal College, Aberdeen AB9 2UE, Scotland.

UNIVERSITY OF EDINBURGH Department of Microbiology

Applications are invited from students normally resident in England and Wales for three

Research Studentships

funded by MAFF

- a) A genetic approach to the study of heat-resistance in food-borne bacteria.
- b) Novel approaches to control of zoonotic pathogens, using by packaging toxins with attractants.
- c) An investigation on the microbiological and biochemical changes during ensilage with and without addition of molasses and microbial inoculum.

Applications to and further details from the Secretary, Department of Microbiology, University of Edinburgh, King's Buildings, West Main Road, Edinburgh EH9 3JG.

CASE STUDENTSHIP IN COMPUTATIONAL MATHEMATICS

A CASE Research Studentship is available from 1986 at the Royal Military College of Science is faculty of the Cranfield Institute of Technology in Sharncliffe. This offers a unique opportunity for a graduate or postgraduate with a mathematics, computing, or related background to obtain an MPhil/PhD degree in computational mathematics, while obtaining direct experience in antenna array design, a key area in modern electromagnetics and communications.

The project, on "phase-only synthesis of two-dimensional antenna arrays", will develop computer algorithms for determining antenna parameters for physically realisable radiation patterns. Resulting constrained least squares and minimax polynomial approximation problems will be tackled by mathematical programming and related techniques.

The collaborating body is the Admiralty Research Establishment and a normal SERC award will be supplemented by a contribution of £620 per annum.

Enquiries should be addressed to:
Professor J. Masek
Computational Mathematics
Group
RMCS
Sharncliffe, Swindon
Wiltshire SN6 6LA
Tel (0793) 782551 Ext 2311

UNIVERSITY COLLEGE CARDIFF

Department of Zoology

NERC STUDENTSHIPS

Applications are invited for the following research studentships in the above department:

1. Cellular swimming in marine mussels in relation to the loss of adaptability (CASE award with NERC Institute for Marine Environmental Research) (Professor D. Bellamy and Dr M. N. Moore).
2. Influences of predator-prey relationships on variability in ladybird colour patterns (Dr P. M. Brakefield and Dr R. J. Cowie).
3. Host-feeding strategies in Hymenopteran parasitoids (Dr M. A. Jervis and Dr N. A. C. Kidd).

For further details contact The Departmental Secretary, Department of Zoology, University College, Cardiff CF1 1XL. (Tel: 0222 874804) enclosing stamped addressed envelope. Ref 3084.

UNIVERSITY OF DURHAM

Department of Botany RESEARCH STUDENTSHIP

Applications are invited for a three year research studentship funded by the SERC Biotechnology Directorate, to work on either the molecular basis of pollen-stigma incompatibility phenomena in *Brassica* crop plants, or the transfer of *Brassica* S-locus glycoprotein gene to Sunflower.

The post is suitable for a graduate with a first or upper second class degree in Molecular Biology, Biochemistry or other relevant biological subject.

Applications, naming two referees, should be sent to Professor D. Boulter, Department of Botany, Science Laboratories, South Road, Durham DH1 1LE, by 3 May, 1986.

HERIOT-WATT UNIVERSITY

Department of Chemistry

Applications are invited for the following two SERC funded earmarked studentships available from October 1986.

(i) **New Ionic Conductors**—this project will involve the synthesis, structural and electrical characterisation of new ionically conducting solids and their application in novel portable power sources.

(ii) **Ion/Molecule Reaction Dynamics**—this project will involve the selection of ions in known electronic states, their excitation to a known kinetic energy, followed by chemical reactions with neutral molecules.

Candidates must have obtained, or expect to obtain, a first or upper second class honours degree.

Applications, together with the names of two referees should be sent to Dr P. G. Bruce for project (i) or Dr J. E. Parker for project (ii) both at the following address:

Department of Chemistry, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, from whom further particulars may be obtained.

UNIVERSITY OF BIRMINGHAM

Department of Plant Biology

Research Studentships

1. SERC CASE, Molecular Biology of plant tissue culture, in relation to the National Vegetable Research Station.
 2. SERC CASE, Physiology and genetics of "non-backcrossing" in wild potato species (with Food Research Institute).
 3. SERC CASE, Development of novel plants to control mold growth in food factories (with International Potato Centre).
 4. SERC CASE, Algal interference with water treatment processes (with Severn Trent Water Authority).
 5. SERC Quota, with projects in the following areas: plant molecular and cell biology, biotechnology, plant pathology, ecophysiology, aquatic biology, crop improvement and gene conservation.
 6. NERC CASE, Physiological ecology of freshwater chrysophytes (with Freshwater Biology Association).
- Details and application forms from: Professor J. A. Callow, Department of Plant Biology, University of Birmingham, PO Box 363, Birmingham B15 2TT.

UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Agricultural Biochemistry and Nutrition

SERC CASE STUDENTSHIP

Applications are invited for a SERC CASE Studentship in collaboration with the Centre for Applied Microbiology and Research (Salisbury, Wiltshire). The research project involves the isolation and characterisation of genes encoding clostridial bacteriocins and the corresponding immunity proteins. Candidates should be expected to obtain a first or upper second class Honours degree in Biochemistry, Microbiology or related subject.

Applications (including the names and addresses of two referees) should be sent to Dr H. J. Gilbert, Department of Agricultural Biochemistry and Nutrition, The University of Newcastle upon Tyne, NE1 7RU (Tel 0632 328511, Ext 4351) to arrive within three weeks of the appearance of this advert.

MEDICAL RESEARCH COUNCIL BLOOD PRESSURE UNIT

RESEARCH STUDENTSHIP

Applications are invited for a three year research project leading to a postgraduate degree. The project will be concerned with the control of steroid hormone secretion from the adrenal cortex, in particular the role of cell fluxes, and will involve techniques of cell growth and manipulation, as well as the development of electrolyte and endocrine assays. Applicants should have, or expect to obtain, a first or upper second class honours degree.

Replies to Dr R. Fraser, MRCS Blood Pressure Unit, Western Infirmary, Glasgow G11 6NT.

IMPERIAL COLLEGE

Mechanical Engineering Department

RESEARCH STUDENTSHIP

Applications are invited for a SERC CASE Research Studentship in cooperation with BP Research Centre, Middlesex. The research project is concerned with identifying and measuring interactions across model polymer-ceramic and polymer-metal interfaces and developing new techniques for increasing the environmental stability of interfaces. The project will employ a number of advanced techniques such as surface analysis and continuous fracture mechanics. The studentship is available from October 1986 for three years and the successful applicant will register for a PhD degree and join a multidisciplinary team working on various aspects of adhesion, structural adhesives and composites.

Applicants should hold, or expect to gain, a first or upper second class Honours Degree in Materials Science, Engineering, Polymer Science or Physics, or a MSc degree.

A full cv and the names of two referees should be forwarded to Dr A. J. Kinloch, Imperial College, Department of Mechanical Engineering, Exhibition Road, London SW7 2BX (Tel: 01-589 5111, ext 6178/8178), from whom further details may also be obtained.

UNIVERSITY OF READING

Department of Applied Statistics

SERC CASE STUDENTSHIP

Applications are invited for a SERC CASE Studentship, in collaboration with the University Research Port Sunlight Laboratory and tenable for a period of three years. The research project involves the development of methods for quantifying environmental contamination in production of detergent products. A typical problem will involve up to 12 factors, with a posteriori responses and the statistical methodology required must incorporate the substantial prior knowledge of the scientists involved, and the use of modern computing facilities.

Applicants should have a first degree involving a substantial amount of statistics and, preferably, a postgraduate qualification in statistics.

Research Studentships in other areas of statistics may be available. In the Department, and another CASE Studentship with Gilett U.K. Limited will be available. Enquiries are welcome.

Further details may be obtained from Professor R. Mead. Applications with the names of two referees, should be sent as soon as possible to Professor R. Mead, Department of Applied Statistics, University of Reading, Whiteknights, Reading RG6 2AN.

SCHOOL OF ELECTRICAL ENGINEERING AND APPLIED PHYSICS

SERC CASE STUDENTSHIP

FIBRE OPTIC TEMPERATURE SENSING USING NON-LINEAR OPTICAL TECHNIQUES

Applications are invited from students in physics, chemistry, electronic engineering or a related subject for a SERC CASE studentship in association with the Optical Sensors Collaborative Association (OSCA), London, to develop and study non-linear optical techniques for distributed fibre optic temperature sensing applications. OSCA is a body which brings together industrial and academic groups working in the fibre optic field and the student appointed would have a wide access to such firms and their expertise.

Students should have [or expect to have] a First or Upper Second Class Honours Degree or an equivalent qualification. In addition to normal SERC support, a contribution of £800 pa for three years is paid to the student.

For further information, please contact:

Dr K. T. V. Grattan, School of Electrical Engineering and Applied Physics, The City University, Northampton Square, London, EC1N 4HT. Tel: 01-253 4399 Ext 4407.

WYE COLLEGE

(University of London)

Molecular Plant Pathology

SERC/CASE RESEARCH STUDENTSHIP

Applications are invited for a postgraduate studentship to apply techniques of molecular biology to studies on the mechanisms of pathogenicity in *Pseudomonas phaseolicola*, the cause of halo blight disease in *Phaseolus*. Collaboration is with Shell Research Ltd, at Sittingbourne.

Candidates must have, or expect to gain, a first or upper second class degree. Some experience in Molecular Biology or Biochemical Plant Pathology is required.

Applicants should write enclosing a cv and the names of two referees to Dr J. W. Mansfield, Biological Sciences Department, Wye College, (University of London), Ashford, Kent TN25 5AH.

UNIVERSITY OF EDINBURGH

Department of Meteorology PHYSICISTS AND MATHEMATICIANS

In possession of a good honours degree are invited to apply for a NERC funded research CASE studentship in conjunction with the Meteorological Office. The successful applicant will study for the degree of PhD, the methods by which the three dimensional distributions of temperatures and trace gases can be determined by measurements from satellites.

For further details and application forms write to Dr R. S. Harwood, Department of Meteorology, The University, James Clerk Maxwell Building, King's Buildings, Mayfield Road, Edinburgh EH9 3JZ. Students are invited to enquire about the availability of other PhD projects.

UNIVERSITY OF MANCHESTER

Department of Biochemistry

SERC-CASE

RESEARCH STUDENTSHIPS

Applications are invited from British undergraduates in biochemistry or a related subject who possess the expectation to obtain a first or upper second class honours degree for the following studentships: (1) To study the specific targeting of vesicles to bio-surfaces by covalently linking lectins and monoclonal antibodies to vesicle surfaces. Supervisors, Dr M. N. Jones in collaboration with Dr I. G. Lyle at Unilever Research, Port Sunlight Laboratory. (2) To investigate the interaction between lysosomal and bacterial autolytic enzymes in the digestion of arthritis-inducing microbial cell walls by phagocytes. Supervisors, Dr J. S. Thompson in collaboration with Dr R. F. Collins of May & Baker, Dagenham, Essex. (3) To investigate the effects of drugs on the metabolism in peroxisomes with particular emphasis on steroids. Supervisors, Dr K. Burdett in collaboration with Dr P. Johnson Smith, Kline Research Ltd, Welwyn Garden City. Applications, including a cv and the names and addresses of two referees should be sent to Dr Keith Burdett, Department of Biochemistry, The University, Manchester M13 9PT.

WYE COLLEGE

(University of London)

Department of Horticulture

Applications are invited for a

SERC CASE RESEARCH

STUDENTSHIP

in co-operation with the Wellcome Foundation Ltd. The research project involves the study of *in vitro* methods of propagation of *Digitalis lanata*, cultivated for the production of medication in the treatment of heart disease. The project will provide a research training in tissue culture, aspects of plant physiology and physiological analysis techniques. The studentship is valued at normal SERC rates with an additional contribution from the Industrial Sponsor.

The successful candidate who will be registered for a PhD, should hold, or expect to gain, a First or Upper second Class Honours degree in Plant Science, Horticulture, Applied Plant Science or a related discipline.

Applications, including a cv and the names of two referees should be sent to Dr E. K. Goldwin, Horticulture Department, Wye College, Nr Ashford, Kent TN25 5AH.

UNIVERSITY OF LEICESTER

Department of Physics

Applications are invited for

RESEARCH STUDENTSHIPS

tenable from October, 1986 and leading to the degree of PhD in the following areas:

Condensed Matter Physics
Ionospheric Physics
Nuclear Electronics
Quantum Molecular Physics
Radiation Physics
Theoretical Physics
X-Ray Astronomy

The Studentships provide an opportunity to join an active Department engaged in research in topics of fundamental and technological interest. They will be suitable for graduates in Physics, Chemistry, Mathematics or Engineering.

Applications, which should include the names of two referees, should be sent to Dr C. Norris, Department of Physics, University of Leicester, Leicester LE1 7RH.



RESEARCH STUDENTSHIP IN PLASMA CHEMISTRY At The University of Zurich

Applications are invited for an ICI sponsored post graduate studentship in plasma chemistry at The University of Zurich. The successful candidate will carry out research on the growth of thin films of inorganic semiconductors and insulators using plasma enhanced chemical vapour deposition techniques. He/she will work in the Department of Inorganic Chemistry under the direction of Professor S Vepreck and in close collaboration with scientists from ICI's New Science Group.

The studentship is tenable from October 1986 for a period of three years and will lead to a PhD. Applicants should have, or expect to obtain a first or upper second class honours degree in Chemistry or Physics from a British University or Polytechnic.

Applications together with a CV should be sent to:

Mr R E Neale

Personnel Officer

Imperial Chemical Industries

New Science Group, PO Box 11.

Closing date: 22nd May, 1986

LIVERPOOL POLYTECHNIC

School of Pharmacy

SERC CASE STUDENTSHIP

"A Clinical and *in vitro* study of the mechanisms of action of the novel antidepressant, Rolipram".

Applications are invited for an SERC CASE studentship to work with Dr A. J. George on the above topic, commencing 1 October, 1986. The project includes pharmacological and biochemical investigations with particular emphasis on membranes, receptors and enzymology. The research collaborator is Dr R. Dorow of Schering A.G., Berlin, F.R.G. where the student will spend a six month research period.

Applicants should have or expect to obtain a first or upper second class Honours degree in either, Biochemistry, Pharmacology or Pharmacy. For further particulars contact the Personnel Officer, Liverpool Polytechnic, Rodney House, 10 Mount Pleasant, Liverpool L3 5UT (Tel 051 207 3581 Ext 2518/2519) to whom a cv with details of final year project and two referees must be sent no later than 16 May, 1986.

University of Birmingham
Department of Zoology and
Comparative Physiology

RESEARCH STUDENTSHIPS

SERC (QUOTA) to study the physiology of feeding behaviour in a range of subjects. (Supervisor: Professor P. J. Butler)

MAFF (QUOTA) to investigate the role of olfaction in the location of the cabbage root fly by its natural parasite. (Supervisor: Dr M. Anderson)

Applicants should have, or expect to obtain, a first or upper second class honours degree in a relevant subject. Further details may be obtained from the relevant supervisor, Department of Zoology and Comparative Physiology, University of Birmingham, Birmingham B15 2TT.

UNIVERSITY OF OXFORD

DEPARTMENT OF ZOOLOGY

SERC CASE RESEARCH STUDENTSHIP IN BIOLOGICAL IMAGE PROCESSING

The SERC has awarded a CASE Research Studentship tenable from 1 October, 1986 for a project entitled "Three-dimensional imaging of cultured fibroblasts and muscle cells after intracavity scanning labelling by confocal laser scanning fluorescence microscopy".

Applicants, who should ideally have or be taking a first degree in physics, biophysics or a related subject, with a sound background knowledge of optics, and image processing and experience in computer programming, should apply without delay to Dr David Shotton, Department of Zoology, South Parks Road, Oxford OX1 3PS (phone (0865) 557858), sending a cv and the names of two referees.

UNIVERSITY COLLEGE

LONDON

RESEARCH STUDENTSHIP

An MRC postgraduate studentship is available from October 1986 for research in speech processing, production and perception.

The work may relate to purely *in-house* research in speech and hearing with normal and impaired adults and children, or with Guy's Hospital and Cambridge University in related work aimed at the development and assessment of new signal processing acoustic and electrocochlear tests.

CV and the names of two referees to Prof A. J. Fourcin, Department of Phonetics and Linguistics, University College London, Wolfson House, 4 Stephenson Way, London NW1 2HE.

THE UNIVERSITY OF

NOTTINGHAM

Department of Biochemistry

Applications are invited for

SERC CASE RESEARCH

STUDENTSHIPS

available from 1 October, 1986 to work with the following supervisors on the research topics indicated:

Dr M. A. Bilet (with Dr P. J. O'Connor, Paterson Laboratories, Manchester). Persistence of carcinogen damage in specific regions of the genome, involving monoclonal antibodies to DNA-adducts, chromatin fractionation and cloned oncogenes to study cell lines transfected with cloned DNA repair genes.

Professor D. N. Brindley (with Beecham Pharmaceuticals). Regulation of hepatic uptake of lipoproteins, involving studies with cultured cells of the effects of drugs and hormones on uptake of high and low density lipoproteins.

Dr G. Coleman (with Department of Agriculture and Fisheries for Scotland, Marine Laboratory, Aberdeen). Formation and isolation of extracellular protein virulent factors of the fish pathogen *Aeromonas salmonicida*.

Professor J. N. Hawthorne (with Beecham Pharmaceuticals). Phosphonitrides and the allergic response, involving control of phosphonitride-hydrolysing enzymes.

Professor P. W. Hemming (with ICI Pharmaceuticals Division). Glycosylation of the EGF receptor in malignancy, involving biosynthetic and immunochemical studies and receptor assays on cultured cells.

Dr R. J. Mayer (with Pfizer Central Research, Sandwich, Kent). Neuronal degeneration: an *in vitro* model, involving cellular micro-injection techniques to probe cytoskeletal functions.

Further details may be obtained from the supervisor concerned. Applicants should possess or expect to obtain this summer a first or upper second class honours degree in a relevant life science subject. Letters of application should be accompanied by a full cv and the names of two academic referees. They should be sent to the appropriate supervisor at the Department of Biochemistry, Nottingham University Medical School, Nottingham NG7 2UH as soon as possible.

UNIVERSITY OF SOUTHAMPTON

Department of Microbiology

RESEARCH STUDENTSHIP

IN MOLECULAR BIOLOGY

Applications are invited for an MRC funded Research Studentship leading to the degree of PhD. The project will involve application of the techniques of molecular biology and protein chemistry in an active group studying the structure and immunohistochemical surface proteins of pathogenic bacteria.

Applicants should have or expect to obtain a First or Upper Second Class Honours Degree in Molecular Biology, Biochemistry or a related discipline. Further details may be obtained from Dr J. E. Heckels, Microbiology, Faculty of Medicine, University of Southampton, Southampton General Hospital, Southampton SO9 4XY. (Tel 0703-777222 Exts 3918/3999) to whom applications, including cv and the names and addresses and telephone numbers should be sent as soon as possible. Please quote ref no AJS/86/26/NS.

UNIVERSITY OF LIVERPOOL Genetics and Botany Departments NERC RESEARCH STUDENTSHIP

Applications are invited for a three year NERC research studentship, commencing 1 October, 1986, to work on the genetics and biochemistry of the production of extracellular precipitates by fungi in relationship to heavy metal tolerances. Applicants should possess or hope to obtain at least a II.1 honours degree in Genetics or Biochemistry, or other relevant biological subject. Further information can be obtained from the joint supervisors Dr B. Tomsett, Tel 051-709 6022, Ext 3110 or Dr D. A. Thurman, Ext 2388. Applications, together with the names of two referees, should be sent to The Registrar, The University, PO Box 147, Liverpool L69 3BX. Quote ref RV/725/NS.

UNIVERSITY OF NOTTINGHAM Department of Botany CASE STUDENTSHIP

Applications are invited from candidates who already hold, or expect to obtain, a good honours degree (1st or 2nd classification) in Botany, Biology or an Agricultural Science, for a CASE Studentship to investigate the improvement of the ornamental chrysanthemum using somatic techniques. A cv, together with the names of two referees, should be sent to Dr M. R. Davey, or Dr J. B. Power, Plant Genetic Manipulation Group, Department of Botany, University of Nottingham, Nottingham NG7 2RD to arrive not later than 23 May, 1986.

SUNDERLAND POLYTECHNIC

Chemistry Division, Department of Physical Sciences

TWO RESEARCH STUDENTSHIPS

are available from Autumn 1986 for up to three years, subject to satisfactory progress, leading to the degree of PhD (CNA).

1. AFRC/CASE studentship sponsored by ICI Bioproducts (Billingham) involving investigation of the materials properties of fungal meat analogues with particular reference to water distribution in the products and during processing. NMR relaxation will be a major investigative technique.

2. Synthesis of organic heterocyclic monomers and investigation of their polymerisation to novel materials with unusual electrical and mechanical properties, sponsored by the British Technology Group.

Applicants for post 1 should have, or expect, a first or upper second class Honours Degree in Chemistry, Physics, or Biology or a related discipline, and for post 2 a first or second class Honours Degree in Chemistry, or Chemistry with a related subject.

Salary: £5544 pa – £6321 pa (both posts on Polytechnic RA Scale).

Application forms, which should be returned by 24 June, (although late applications may be considered), and further particulars may be obtained from The Personnel Officer, Sunderland Polytechnic, Langham Tower, Ryhope Road, Sunderland SR2 7EE. Tel Sunderland (0783) 76231 Ext 11, or by telephoning the Dept on Sunderland (0783) 76191 Ext 147.

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Electronics plus some chemistry background. Wide experience in analytical customer service, with leading companies, nine years shortly to settle in south England seeks serious career with major analytical instrument manufacturer/supplier, on major analytical instructor user. Box D925.

PHD ANALYTICAL CHEMIST

(30) Imaginative and literate, experienced in energy, pharmaceutical and fundamental research management requires responsible position in Bristol Area. Box D923.

MISO

BSc Hons. 11 years experience seeks challenging post abroad, especially Australia/USA. Anything considered. Box No D924.

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(With a minor in Astronomy 2nd class) requires position. Preferably involving Fibre Optics, although all relevant. R & D work considered. Box D919.

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ARIADNE

WHAT will they think of next? The *New York Herald Tribune* reports: "Chinese prolong life of mummies". □

I AM NOT sure of the precise meaning of the American word "flaky", but it was applied to a publication—*Californian*, what else—that has over 100 pages of advertisements for "resources for personal transformation". And eye-opening some of them are. I had no idea that, for example, Star-seed Crystals were discovered in Brazil and that they are considered to have been delivered here by higher life forms to aid in the positive transformation of the planet. Nor did I know that you can buy a legless dummy called Hit-me-Hug-me-Hermie that you can embrace or attack for the good of your health.

Astrology and "natural" foods are both well represented, of course. I am still trying to work out the message of "A book is to the truth as your grocery list is to the food". □

WORD PROCESSORS are better than typewriters, I repeat to myself with counterfeited conviction. Once again: word processors are better than typewriters. I am staring at the screen of the most widely used machine, according to report, and on it is the last page of an item for this column. Well, most of it. It has holes in the middle, parts of lines elsewhere and across the top is a jam of half-written instructions and several hundred of the letter X, in rows. Neither will this picture change. It remains immovable, whatever key I press.

The machine is, for all practical purposes, dead.

The unfortunate thing is, unprepared for the demise, I have not copied the screen, taking it all down in longhand. There is nothing for it but to switch off entirely and start again. On a jammed typewriter, I would still have all the copy up to the point of failure.

But word processors are better than typewriters: except when they fail. Ariadne's Law is that a faulty typewriter is better than a faulty word processor. □

A NOTHER gadget to put the wind up smokers is on the market. Even down in the FOREST something might stir when faced with it. The Health Education Council and GMI, a firm in Scotland, have developed an instrument that works in roughly the same way as the Breathalyzer. Breathe into it and it will show immediately how much carbon monoxide you have dosed your lungs with after inhaling cigarette smoke.

The more you have absorbed, the higher a number appears and worsening measurements turn a colour display from green to red through amber. Your complexion may also change from white to red because the thing bleeps as well, getting louder, to your discomfort, as the carbon monoxide figure goes up.

Judging by the fury and anguish that characterises the tobacco lobby whenever cigarette smoking is attacked, GMI and the

Health Education Council might find the going a bit rough in selling the monitor, dramatic as it seems to be. □

IT MUST be 30 years or more since MPs got up in the House of Commons, waving packets of irradiated food prepared for the US Forces and demanded to know why such a process, using gamma radiation from radioisotopes to sterilise the food and make its shelf life practically unlimited, was not available in Britain. Since then, the method of sterilisation has been used for treating surgical dressings and hypodermic needles, for instance. But now comes another stage.

According to rumour, the DHSS will approve the use of irradiation to sterilise food, later in the year. When the MPs were doing the waving, the term "nuclear" was still one that bordered on the magical. It was certainly not one to make people turn white and clutch the seats of their chairs. But times have changed. So well has the campaign against nuclear energy succeeded that hysteria seems to be the common reaction to any development. Already, the starting signal has been given in the form of the recent White Paper on the subject, the critics are well down the course and increasing speed.

They are half-convinced that irradiation will make foodstuffs radioactive and they are fully convinced that deleterious changes in food flavours and textures, investigated in research on the method, mean that awful-tasting meat and disgusting dairy products will be on sale in supermarkets. A fat lot of good that would do to Sainsbury's or Waitrose.

Another banner being raised expresses concern for workers who may be employed in sterilisation plants for treating food, on the grounds that they will be exposed to radiation. No such concern has been shown for those who already work on the surgical goods or in hospitals in fighting disease by radiation. Neither do the critics refuse these goods or services.

I fear that most of those in full cry about the yet-to-be-revealed schemes are as susceptible to reason as much of the audience watching a demonstrating engineer drink a glass of the purified water issuing from a sewage works. □

I DROVE round a roundabout twice to make sure. Could it be true that the publishers of *Today*, the daily newspaper, are recommending that you read it because the ink it is printed with does not come off on your fingers? It was. There were two enormous advertising hands, one clean, one dirty, to show the long-awaited advance of ink that stays on the paper.

Say farewell to grubby fingers, black stains on shirts and dirty raincoats that cause hostile glances and shiftings along the bench. As I have carried on about



the problem in this column once, I suppose that I should honestly welcome technology galloping to the rescue. Nevertheless, it seems a less than convincing reason for buying a newspaper. □

DAEDALUS salutes the recent production of hollow football-like graphite molecules by focusing a laser beam onto a graphite surface. Daedalus, who published detailed predictions of hollow graphite molecules years ago, points out that other substances with sheet molecules, such as molybdenum disulphide and mica, should also fragment into flakes that curl up into ball molecules under the same treatment. He awaits news of hollow molecules of these substances in the near future. To maintain his lead in the field, Daedalus now proposes a variant of the technique. He suggests imaging a standing-wave laser-light pattern onto the sheet-molecule surface.

This process, used at low powers to make diffraction gratings, should at high powers detach the sheet molecular fragments not as round flakes but as strips. They will therefore roll up to form cylinders rather than spheres. These long hollow "macaroni molecules" will have such a low bulk density and weak interactions with each other that at ordinary temperatures they will be supercritical gases.

Even in a few parts per million, long-chain polymers dissolved in water can make it very viscous. Daedalus expects his new long-chain polymer gases to have the same effect in air. Just a trace of "viscovapour" in the air will dramatically raise its viscosity. The primary result will be to damp out noise, which will be absorbed by a few feet of travel. Daedalus's "Instant Silence" aerosol will bring peace and quiet to any room, despite traffic outside, pop-music next door, and screaming kids in the corner.

A second useful effect will be the damping of draughts and heat convection. With viscovapour, one's clothes will feel warmer, domestic heat will not rise so rapidly to the ceiling, and draughts round the ankles will be checked. This new environmental benison should bring peace and warmth to households worldwide. □

**Promoting
innovation**

No. 10 – ELECTRIC COFFEE MACHINES

The Problem

When centrifugal filters are used to brew coffee, rotation of the filter causes ground coffee to be thrown to the outside of the annular filter chamber, the brewing water then having to pass outwardly through the layer of coffee. The radial thickness of this layer is directly proportional to the number of cups required. This means that considerably more resistance is encountered by the brewing water when making two or more cups than when making just one. This leads to undesirably large differences in brewing times for one or more cups.

A Proposed Solution

By providing a successively stepped annular filter chamber¹, an outer axially shallow but radially thick sub-chamber is formed with a volume corresponding to one cup. The next sub-chamber formed inwardly thereof has the same volume, but is axially deeper and radially thinner, so that the relative increase in resistance to the brewing water is less than before, and there is a correspondingly smaller difference between the brewing times for one or two cups. Further sub-chambers have successively smaller radial widths.

The patent specification referred to may be consulted at the Science Reference Library and the Science Museum Library in London, and at several of the reference libraries comprising the Patents Information Network which are located in 26 towns throughout the UK.

British, European and foreign patent specifications in this particular field are indexed under A47J of the International Patent Classification. British specifications are *also* indexed under A4E of the British Patent Classification.

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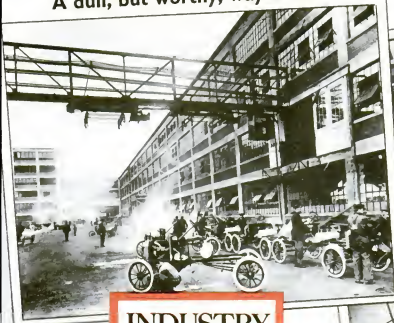
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Tell us in about 1500 words what YOU think of industry. Does it excite you? Would you consider a career in a science- or technology-based industry? If you wouldn't, suggest what industry is doing wrong. Why isn't the idea of industry attractive to you?

Something to think about in writing the essay would be to say why you fancy a future in computing, engineering, chemistry or biological research. Or why you would rather be a teacher, doctor, salesperson or farmer?

We want to know what YOU think. Your essay may be accompanied by drawings, photographs or collages to enhance the points that you make. The competition is open only to people who live in the British Isles and who are between 11 and 18. The judges will take into account entrants' ages.

Entries should be typed or written in English, using only one side of the paper and double spacing. On the top left-hand corner of the first page give your full name, home address and date of birth. Put your name on every sheet. The competition closes on 6 June. The judges will include Peter Briggs of the British Association for the Advancement of Science, and Richard Ffield and Marcus Chown of *New Scientist*. Post your entry to "The Face of Industry", Karen Iddon, Room 126, Commonwealth House, 1-19 New Oxford Street, London WC1A 1NG.

The names of the winners will be published in *New Scientist*. The winners will be offered bursaries to attend, free of charge, the annual meeting of the British Association at the University of Bristol from 1-5 September 1986. The winners and five runners-up will be given a free subscription for one year to *New Scientist* and one year's membership of BAYS.